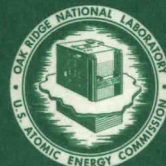


Radionuclide Movement in Soils and Uptake by Plants

A Selected, Annotated Bibliography



OAK RIDGE NATIONAL LABORATORY

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RADIONUCLIDE MOVEMENT IN SOILS
AND UPTAKE BY PLANTS
A SELECTED, ANNOTATED BIBLIOGRAPHY

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AUGUST 1975

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INTRODUCTION

This selected annotated bibliography was originally assembled as an information retrieval data base for the purpose of writing a comprehensive literature review by C.W. Francis on the movement of radionuclides in soil and uptake by plants. The data base was started when it became apparent that only through such a retrieval system could the voluminous amount of literature be critically surveyed. The data base is a result of literature searches from 1948 to 1975. It contains information on how various chemical, physical, and biological factors influence the movement of radionuclides in soils and uptake in plants. As a result of public concern about radioactive fallout prior to the moratorium on nuclear testing in the atmosphere, much of the data is related to the major fission products in radioactive fallout, strontium-90 and cesium-137. A concentrated effort was made to select the literature that dealt with processes affecting the movement and biological availability of radionuclides. Consequently literature in which the major purpose was to report concentrations of radionuclides in soils and plants, such as monitoring type reports, was not included. The data base includes references to nearly all fission products, a large number of biologically important activation products and various naturally occurring radioactive nuclides such as uranium and thorium. The Russian literature has been carefully surveyed, and the data base probably represents the most complete bibliography on research efforts in the USSR related to radionuclide transport in soil-plant systems.

Citation Form

The bibliographic data were arranged according to the Environmental Information System standard format for computer entry of information.

As a result of computer limitation in indicating superscripts and subscripts in the standard manner, certain conventions have been established in the bibliography:

- 1) "X sub t" (X being a variable) means X_t or X subscript t.
- 2) In chemical compounds and elements, "NaIO3" means NaIO_3 .
- 3) "10(E+3)" or "X(E-3)" (E denoting exponent) means 10^3 or X^{-3} , respectively.
- 4) For units of measurement, such as cubic centimeters or square feet, X3 means X^3 .

Indexes

Indexes are provided for: 1) author, 2) keyword, 3) geographic location, 4) taxon, and 5) title (alphabetical listing of keyword-in-context of the nontrivial words in the title).

ACKNOWLEDGEMENTS

Nuclear Sciences Abstracts (NSA) and Soils and Fertilizers were the sources of some of the references in this bibliography. The references and abstracts were taken from NSA, volumes 14 through 29, and Soils and Fertilizers, volumes 25 through 36.

B.N. Collier and C.T. Sanders of the Ecological Sciences Information Center collected, input, and edited some of the original documents for C.W. Francis.

Machine processing for this document was done by the Data Processing Center, Information Center Complex (ICC). Faye Fletcher of ICC and Ruth Slusher of the Computer Sciences Division carried out the computer production of this document. The computer programs supporting the composition and indexing for this bibliography constitute a part of the Oak Ridge Computerized Hierarchical Information System (ORCHIS).

<1>

Aarkrog, A., On the Direct Contamination of Rye, Barley, Wheat, and Oats with Strontium 85, Cesium 134, Manganese 54, and Cerium 141. 1969. Radiation Botany, 9, 357-366 (Danish Atomic Energy Commission, Agricultural Research Department, Risoe, Roskilde, Denmark)

Radionuclides of Sr, Cs, Mn and Ce were applied as a spray to spring varieties of rye, oats, barley, and wheat at four different stages of development. The Cs and Mn concentrations in the grain were higher than the concentrations of Sr and Ce. The ratios Cs/Sr, Cs/Ce, Mn/Sr, Mn/Ce, and Sr/Ce in the grain increased with the time between spraying and maturity. Field loss of Sr was greater than for the other nuclides applied. The "half-lives" for the Sr-loss was calculated as about 3 weeks as compared to 4 to 5 weeks for Mn and Ce and probably even longer for Cs. (Auth)

<2>

Aarkrog, A., and J. Lippert, Direct Contamination of Barley with Chromium 51, Iron 59, Cobalt 58, Zinc 65, Mercury 203 and Lead 210. 1971. Radiation Botany, 11, 463-472 (Danish Atomic Energy Commission, Health Physics Department, Research Establishment Risoe, Roskilde, Denmark)

A study of barley sprayed at six different stages of development with radionuclides of Cr, Fe, Co, Zn, Hg and Pb is described. The initial retention followed the equation: $IR = 1 - e^{-(E-0.31q/cm)}$, where q is the dry weight of the herbage in a plot in grams, and cm the height of the plants at spraying. The field loss depended on the growing rate and the development of the plants and thus varied throughout the growing period. The field loss coefficient λ was 0.054/days in the first part of the period and 0.017/days in the second part. If the whole growing season is considered, the loss of activity in percent is about equal to the time in days from the spraying to harvest. Zn and Co showed the highest concentrations in the grain. The translocation of Cr, Pb and Hg within the plant was small. Fe was translocated to the grain as was Zn, but to a far less extent. (Auth)

<3>

Abdullaev, K.H., B.B. Zakhvataev, and V.P. Perelovin, Determination of the Uranium Concentration in Plants According to Traces of Uranium Fission Fragments. 1968. Radiobiologiya, 8, 765-766 (Joint Institute of Nuclear Research, Dubna, USSR)

The use of lysis to measure the uranium concentration in plants by recording fission fragments of U 235 in thermal neutron fluxes is described. The use of external detectors of organic polymers permits a determination of very low uranium concentrations in plants. (NSA)

<4>

Adams, C.E., W.H. Farlow, and W.R. Schell, The Compositions, Structures and Origins of Radioactive Fall-out Particles. 1960. Geochim. Cosmochim. Acta, 18, 42-56 (U.S. Naval Radiological Defense Laboratory, San Francisco, CA)

The chemical compositions, structures and modes of origin of several different types of radioactive fallout particles have been determined through petrographic techniques, X-ray diffraction analysis, radioautography

and specially prepared reagent films for liquid fallout. The fallout particles studied were collected following the detonation of nuclear weapons under various conditions at both the Nevada Test Site and the Eniwetok Proving Grounds. Radioactive fallout particles were formed by the interaction of the condensing vaporized metals and fission products derived from the bomb and associated structures with the surface material swept up into the cooling fireball. Descriptions of the various types of fallout particles are given and their modes of origin are qualitatively related by a simplified thermodynamic treatment. (Auth)

<5>

Adams, W.H., Solubility of Plutonium 238-Labeled PuO₂ in Los Alamos Tap Water. 1971. LADC-12900; 5p. (Los Alamos Scientific Laboratory, Los Alamos, NM)

The solubility of various sized microspheres of Plutonium 238-labeled PuO₂ over time was determined in Los Alamos tap water. (CWF)

<6>

Adams, W.H., and E.B. Fowler, Plutonium 238 Incorporated in Fish Living in Water Containing Plutonium 238-Labeled PuO₂. 1971. LADC-12899; 8 p. (Los Alamos Scientific Laboratory, Los Alamos, NM)

The transfer of plutonium in the form of Plutonium 238-labeled PuO₂ microspheres from water to fish and snails was measured. (CWF)

<7>

Alban, L.A., and J. Kubota, A Study of Extractable Soil Cobalt in Soils of the Southeastern United States. 1960. Soil Science Society of America Proceedings, 24, 183-185 (U.S. Department of Agriculture, Soil Conservation Service, Soil Survey Investigations, Ithaca, NY)

The relationship between 2.5 percent acetic acid-dithizone extractable soil cobalt and the amount of cobalt in black gum leaves, a cobalt indicator, was investigated for 71 widely distributed soils of the southeastern United States. The soil samples were from both good areas and areas where cobalt deficiency in ruminants would be expected on the basis of previous analyses. The extractable cobalt values appeared to separate the groundwater podzols, the humic-gleys and the low humic-gleys from the better drained regosols and red-yellow Podzolic soils studied. At comparable cobalt concentrations in the black gum, the extracted cobalt was less from the imperfectly to poorly drained soils than from the well-drained soils. For each of the two broad groups of soils, a significant correlation was obtained between extractable soil cobalt for the A sub 1 horizon and the cobalt concentration in the black gum. Because of the variability in horizon thickness among the different soils, the cobalt values were calculated for the 0- to 6- and 0- to 12-inch depths. The correlation between these values and plant cobalt was also good. The acetic acid-dithizone extractable cobalt appears useful in indicating areas of potentially low soil cobalt in the Southeast where deficiency in cattle or sheep might be a problem. (Auth)

<8>

Aleksakhin, R.M., Radioactive Contamination of Soil and Plants. 1963. Publication of the Academy of Sciences, Moscow, USSR, 132 p.

<8> CONT.

Fallout contamination of soil and plants is discussed. Data on fallout rates and plant uptake following nuclear explosions are given. The significance of plutonium 239 uptake by plants, biological effects of fission products (strontium 90 and cerium 137) on agricultural development and plant growth, behavior of plutonium 239, strontium 90, and cesium 137 in soils, reduction of radioactive uptake by plants, and decontamination of soil are considered. An extensive bibliography is included. (NSA)

<9>

Aleksakhin, R.M., Migration of Natural Radionuclides and Their Effects in Terrestrial Biogeocenoses. 1971. Soviet Journal of Ecology, 2(6), 582-583 (Academy of Sciences, Forest Laboratory, Moscow, USSR)

A brief summary of papers presented at the section "Migration of Radionuclides in the Biosphere and Problems of Radioecology" of the USSR Academy of Science is presented. One paper by Varsberg revealed no significant differences in the U, Ra, Th, and K contents between soil types and distribution of these elements in soils. Other papers discussed the distribution of U, Ra, Th, and Po 210 in plants of northwest European USSR and movement of Ra 226 through soils. (CWF)

<10>

Aleksakhin, R.M., R.T. Karaban, N.V. Kulikov, A.A. Molchanov, M.A. Naryshkin, S.V. Tarcheskaya, P.A. Tikhomirov, E.B. Tyurukanova, and P.I. Yushkov. Some Aspects of Radioactive Fission Products Migration in the Forest Biogeocenoses and the Effects of Ionizing Radiations on the Woody Plants. 1970. CONF-690518- (Vol. 2): Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969. (p. 999-1023), 684 p. (Academy of Sciences, Moscow, USSR; Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Fontenay-aux-Roses, France)

The distribution and the migration of the most important radioactive fission products in the different types of forest are given. The migration of radionuclides in different components of forest biogeocenoses is discussed. The distribution of global fallout over the forests of the USSR is reviewed. The effects of ionizing radiations on woody plants are also described. (Auth)

<11>

Aleksakhin, R.M., M.A. Naryshkin, and M.A. Bocharova. Peculiarities and Quantitative Prediction of the Cumulative Accumulation of Strontium 90 in Woody Plants. 1970. Academy of Science, USSR, 193(5), 62-64

Experiments were conducted to investigate the principles of strontium 90 intake into perennial woody plants. Maximum strontium 90 concentrations were found to be 7.2×10^{-10} and 1.4×10^{-11} Ci/g in birch and pine wood respectively when the strontium 90 concentrations in the soils were 3.2×10^{-9} and 2.1×10^{-10} Ci per gram, respectively. (CWF)

<12>

Aleksakhin, R.M., and M.M. Ravikovich. Certain Patterns in the Behavior of Alkaline Earth Elements (Calcium, Magnesium, Strontium) in Forest Biogeocenosis. 1966; 1967. Soviet Soil Science, 4, 414-421; CONF-660405; Part of Aberq,

B. and Hengate, F.P. (Eds.), Radioecological Concentration, Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, 1051 p. (Laboratory for Forest Study, Academy of Sciences, USSR)

The movement of calcium, magnesium and strontium through a soil- birch forest system was evaluated. The calcium and strontium distribution, but not magnesium, in the woody vegetation showed an acropetal pattern. The observed ratios of strontium to calcium varied between 0.4-3.2 while those of the strontium to magnesium varied between 0.3-12.5 in the soil-birch phytocenosis system. (CWF)

<13>

Aleksakhin, R.M., and F.A. Tikhomirov. Radionuclide Migration in Forest Biogeocenoses. 1973. Part of Klechkovskii, V.M. (Ed.) Radioecology, John Wiley and Sons, Inc., New York, New York, (p. 126-140), 381 p. (Not given)

Radionuclide migration and circulation in forest cenoses are reviewed. Some topics discussed are: deposition of radioactive aerosols from nuclear weapons tests and radionuclides discharged from the stacks of nuclear enterprises; fate of radioactive particles deposited from air onto soil-plant cover; effects of particle size, topographical and meteorological conditions, and type of plant cover on horizontal transport of radioactive particles; filtering effect of vegetation on vertical transport of radioactive particles; effects of meteorological conditions and plant characteristics on primary interception by plant cover of radioactive particles; radiation damage to coniferous forests in comparison to deciduous forests; accumulation of radionuclides by forest vegetation from soil; and model experiments on migration of Cs 134 and Cs 137 in forest stands. (NSA)

<14>

Alexander, L.T., Does Salt Water Spray Trap Strontium 90 from the Air?. 1967. HASL-181; Part of Hardy, E.P., Jr., and Rivera, J. (Eds.), Fallout Program Quarterly Summary Report, December 1-March 1, 1967. (U.S. Department of Agriculture, Soil Survey Laboratory, Beltsville, MD)

Results indicated that entrapment of radiostrontium by sea spray over land is not a factor of any appreciable magnitude. (CWF)

<15>

Alexander, L.T., Depth of Penetration of the Radioisotopes Strontium 90 and Cesium 137. 1967. HASL-183; Part of Hardy, E.P., Jr., and Rivera, J. (Eds.), Fallout Program Quarterly Summary Report March 1 - June 1, 1967, (p. I.16-I.21) (U.S. Department of Agriculture, Soil Conservation Service, Beltsville, MD)

The distribution of strontium 90 and cesium 137 in selected soil profiles from the United States, 1959-1966 are presented. (CWF)

<16>

Alexander, L.T., R.H. Jordan, R.F. Dever, E.P. Hardy, Jr., G.H. Hamada, L. Machta, and R.J. List. Strontium 90 on the Earth's Surface. 1961, February. TID-6567; 25 p. (U.S. Department of Agriculture; U.S. Atomic Energy Commission; U.S. Department of Commerce)

Properly selected soil sites may be used to

<16> CONT.

measure the deposited fall-out of Sr 90. Errors due to site selection and radiochemistry appear to be less than 10 per cent as tested by replication. However, the uncertainty in the world-wide Sr 90 fall-out (estimated to be about 4.1 megacuries) is much greater than 10 per cent because of incomplete world-wide sampling. Systematic errors in using soil samples to estimate world-wide fall-out may raise the fall-out integral due to apparently greater oceanic than land fall-out, incomplete extraction of Sr 90 from the soils, and impact on other than horizontal surfaces. The distribution of Sr 90 has become even more unbalanced in favor of the northern hemisphere in 1959 over earlier years because of the almost exclusive deposition of fall-out from Soviet tests in the northern hemisphere. The world-wide integrals have almost doubled between mid-1958 and mid-1959. A relation between the Sr 90 concentration of rain water and the associated long-term amounts of rain water indicates that lower concentrations are found with greater rainfall amounts. It is suggested that this relation is consistent with certain meteorological hypotheses. Strontium 90 fall-out measured by the soil sampling program in eastern United States is relatively uniform. As of 1959 the nonlocal fall-out over the United States from the Nevada Test Site is estimated to be about 0.04 megacuries. (Auth)

<17>

Ambler, J.E., Translocation of Strontium from Leaves of Bean and Corn Plants. 1964. Radiation Botany, 4, 259-265 (U.S. Department of Agriculture, Agricultural Research Service, Soils Laboratory, Beltsville, MD)

Translocation of Sr 85 from leaves of bean and corn plants to plant parts was measured at successive stages of growth. Translocation was greater from leaf applications that were periodically rewetted than from application allowed to air dry and stay dry. From most foliar treatments allowed to air dry and stay dry translocation was less than 0.01 percent of that applied. (Auth) (CWF)

<18>

Ambler, J.E., and R.G. Menzel, Retention of Foliar Applications of Strontium 85 by Several Plant Species as Affected by Temperature and Relative Humidity of the Air. 1966. Radiation Botany, 6, 219-223 (U.S. Department of Agriculture, U.S. Soils Laboratory, Soil and Water Conservation Research Division, Agricultural Research Service, Beltsville, MD)

Absorption of radiostrontium by leaves varied widely among different plant species. Absorption increased with increasing relative humidity and temperature of the air to which leaves were exposed for 24 hours after the applied radiostrontium solution became dry. Differences between species were related to differences in wet ability of the leaves. (Auth)

<19>

Ames, L.L., Jr., Some Cation Substitutions During the Formation of Phosphorite from Calcite. 1960. Economic Geology, 55, 354-362 (General Electric Company, Richland, WA)

The nature of cation substitution during replacement of calcite by phosphorite allows the statistical treatment of data concerning such substitutions. Log-probability plots of

data yield straight lines that allow easy and accurate extrapolations. Data are presented to show the effect of Po 4 concentration, temperature, flow rate, and Na concentration on the primary inclusion of the radioisotopes of Pa, Sr, and Pu. (CWF)

<20>

Ames, L.L., Jr., Cation Exchange Properties of Heulandite-Clinoptilolite Series Members. BNWL-481-3; (p. 54-59) (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

The cation exchange characteristics of a synthetic zeolite, two natural clinoptilolites, and a heulandite were studied. The synthetic zeolite was intermediate in the heulandite-clinoptilolite series on the basis of correlated cation exchange characteristics and chemical composition. Data are presented in tables and graphs. Heulandite was more sodium-selective than clinoptilolite. The cesium selectivity of the zeolite is suggested as a criterion to distinguish between samples within a structural series such as the heulandite. (NSA)

<21>

Ames, L.L., Jr., Trivalent Cerium Equilibria with a Synthetic Heulandite-Clinoptilolite Series Zeolite. BNWL-481-3; (p. 59-63) (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

The cation exchange properties of a synthetic member of the heulandite-clinoptilolite series were determined. Unusually good cerium selectivity was displayed for a high-silica zeolite of this structural series. The zeolite was synthesized in a stirred 1 liter autoclave held at 290 C for 5 days at autogenous pressure; starting materials were LiOH, ground Al(OH)₃, and ground silica gel. Three cerium capacity determinations were performed and the values obtained were 1.14, 1.18, and 1.16 meq Ce/g zeolite. (NSA)

<22>

Ames, L.L., Jr., and B.F. Hajek, Statistical Analysis of Cesium and Strontium Sorption on Soils. 1966. BNWL-CC-539; 10 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

A statistical design to study removal of radioisotopes by a soil was tested. A regression equation was used to predict cesium and strontium removal results, given the level of independent variables. The results indicate the statistical treatment and prediction of radioisotope removal by soils is feasible. (Auth) (CWF)

<23>

Ames, L.L., Jr., J.R. McHenry, and J.F. Honstead, The Removal of Strontium from Wastes by a Calcite-Phosphate Mechanism. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 76-85), 624 p. (Hanford Laboratories Operation, Richland, WA)

Data is presented to support the formation of strontium-carbonate-apatite products in alkaline phosphate solutions. (CWF)

<24>

Amphlett, C.B., Soil Chemistry and the Uptake of Fission Products. 1955. Research, 8, 335-340 (Atomic Energy Research Establishment, Harwell, Didcot, Berkshire, England)

The initial investigations of the soil chemistry of fission products are presented. A number of clay minerals were tested as possible adsorbents for decontamination procedures. Plant uptake was suggested as a possible decontamination procedure for soil strontium 90. (CWF)

<25>

Amy, J.P., Contribution to the Study of Ruthenium 106 Migration in Soils. 1971. CEA-R-4168; 87 p. (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Cadarache, France)

Two solutions of nitrosylruthenium complexes, the states in which ruthenium is released by MARCOULE processing plant, and an uncomplexed solution of ruthenium chloride were used to show ruthenium 106 mobility during earth column percolation. Ruthenium migration was mainly dependent on its ionic state. Anionic forms were mobile in the soil and a large fraction could be found in the percolate whereas cationic states were sorbed more quickly. The nature of the soil played a role too: ruthenium migrated deeply in sandy soils, whereas it was strongly sorbed by the muddy fractions of soils with a mud-sand texture. Ruthenium mobility in the soils studied was found to depend more on the solution percolation rates than on particle size distribution, both factors being however closely connected. (Auth)

<26>

Amy, J.P., A. Grauby, and P. Jacquin, The Mobility of Ruthenium 106 in the Environment and its Movement in Soil Under Irrigation. 1970. Compt. Rend., Ser. D, 271, 644-647 (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Cadarache, France)

Ruthenium 106 was found to be in the form of soluble nitrosylruthenium complexes which moved readily in the environment. Experimental data revealed that this form was adsorbed to sediments in irrigation canals and the concentration in the sediments increased as far as 12 km from the source. Downward movement of ruthenium in the soil was shown to be a function of soil texture and quantity of irrigation water applied. (CWF)

<27>

Amy, J.P., A. Grauby, and P. Jacquin, Ruthenium 106 Migration in Irrigated Soils from the Bas-Rhone. Radioprotection, 5, 185-200 (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Cadarache, France)

Two solutions of nitrosylruthenium complexes, and an uncomplexed solution of ruthenium chloride were used to study Ru 106 mobility during earth-column percolation. Ruthenium migration was mainly dependent on its ionic state. Anionic forms were mobile in the soil and a large fraction could be found in the percolate, whereas cationic states were sorbed more quickly. The nature of the soil was also important: ruthenium migrated deeply in sandy soils, whereas it was strongly sorbed by the muddy fractions of soils with a mud-sand texture. Ruthenium mobility in the soils studied was found to depend more on the solution percolation rates than on particle size distribution, both factors being however

closely connected. (Auth)

<28>

Ananyan, V.L., Effect of Fertilizers on Yield and Radioactivity Level of Alpine Meadow Plants. 1966, March. Agrokhiimiya, 3, 121-126 (Laboratory of Agricultural Chemistry, Academy of Sciences, Erevan, USSR)

The results of field tests showed that the soils of high Alpine meadows were lacking in nitrogen and in phosphorus. The greatest increase of harvest was produced by fertilizers containing these elements plus K. The levels of total beta activity and the radioactivities produced by other isotopes (fission products) were measured in fertilized and nonfertilized areas. The lowest level of total beta radioactivity was detected in plant samples from acreages receiving complete mineral fertilization. (NSA)

<29>

Ananyan, V.L., and A.Sh. Avetisyan, Accumulation of Radium and Calcium in Plants as Influenced by Fertilizers. 1971. Dokl. Akad. Nauk Arm. SSR, 11, 36-41 (Soobshch. Inst. Agrokhiim. Probl. Gidropioniki, Armenia, USSR)

The experiments were carried out in field conditions, both in subalpine meadows and field-vegetation pots on brown soils with lucerne. In the NP and NPK varieties, a high yield of hay was obtained in the meadows. The effect of fertilizers on lucerne is weak. In the subalpine plants (hay) the content of radium in relation to the yield of lucerne is high. When yield of hay is high, there takes place a relative decrease of the contents of radium and Ca. In the variants of NP and NPK the content of radium seems to be increasing slightly. (Auth)

<30>

Ananyan, V.L., and A.Sh. Avetisyan, Contents of Radiostrontium in the Main Soils of Armenia. 1971. Dokl. Akad. Nauk Arm. SSR, 11, 19-24 (Soobshch. Inst. Agrokhiim. Probl. Gidropioniki, Armenia, USSR)

The vertical migration of Sr 90 in the different soils of Armenia and its proportional contents in the upper layer (0 to 20 cm) of those soils were studied. On arid soils, up to 50 to 80% of the Sr 90 is accumulated in the upper layer (0 to 5 cm). Under definite local conditions, Sr 90 is mixed and accumulated in lower layers. (NSA)

<31>

Ananyan, V.L., and B.G. Mnatsakanyan, Uptake of Potassium and Cesium 137 by Alpine and Subalpine Plants as Influenced by Fertilizers. 1971. Dokl. Akad. Nauk Arm. SSR, 11, 42-60 (Soobshch. Inst. Agrokhiim. Probl. Gidropioniki, Armenia, USSR)

The results of the investigation carried out on the meadows of Mt. Aragatz and Gegham mountain ridge zone are discussed. In the experiments of small-size field beds the effect of fertilizers (N, P, K) and liming (CaCO₃) on the yield and the accumulation and relation of potassium and Cs 137 in the plants (hay) was investigated. The accumulation of Cs 137 in the plants was contradictory in relation to their yield. In the NP and NPK varieties, of which a high yield was obtained, the content of Cs 137 diminished. Interdependence between the accumulation of potassium and yield of plants was not observed. The antagonism of potassium was

<31> CONT.

weak, especially in the alpine zone. Liming of soils (without fertilization) showed a positive effect in the alpine zone while in the subalpine zone the uptake of Cs 137 by plants increased. (Auth)

<32>

Ananyan, V.L., and B.G. Mnatsakanyan, Effect of the Level of Relief on the Distribution of Radioactive Elements. 1971. Dokl. Akad. Nauk Arm. SSR, 11, 31-35 (Soobshch. Inst. Agrokhim. Probl. Gidropniki, Armenia, USSR)

The effect of relief on the distribution of natural and artificial radioactive elements on three sub-alpine meadows was investigated. The distribution of Cs 137 depends on the relief. As a rule, its content is slight on the steep slopes, while on the lower ones it is relatively higher. The characteristics of the distribution of the total beta radioactivity is subject to the same rule, with the difference that the changes are not as distinct as the others. The changes in the potassium contents depending on the level of the slopes are weak, and even decrease in some of them. (Auth)

<33>

Ananyan, V.L., and B.G. Mnatsakanyan, Migration of Cesium 137 on Various Soils of Armenia. 1971. Dokl. Akad. Nauk Arm. SSR, 11, 14-18 (Soobshch. Inst. Agrokhim. Probl. Gidropniki, Armenia, USSR)

Studies on the migration of Cs 137 were carried out on three vertical profiles involving the main soil types of Armenia. It was found that the upper layer (0.5 cm) of different soils of Armenia, Cs 137 content represents 65 to 100%. In brown and chestnut soils, migration is greater than in chernozem soils and especially in mountain-meadow soils. Content of Cs 137 increases in soils rich with humus. (Auth)

<34>

Ananyan, V.L., B.G. Mnatsakanyan, and L.A. Araratyan, The Influence of Fertilizers on the Distribution of Stable and Radioactive Manganese 54 in Alpine Field Plants. 1969. Dokl. Akad. Nauk Arm. SSR, 48, 115-119 (Institute of Agrochemical Problems, Erevan, USSR)

The influence of fertilizers (P, N, K) on the uptake of stable and radioactive manganese by hay in the Ararat fields in the Alpines at 3250 m elevation was studied. The mountain field soil was brown with a high content of organic substances and normal contents of nitrogen and phosphorus. The soil had an acid reaction and the pH of the water was 4.4. Manganese 54 was present in the upper layer to a depth of 5 cm. Data obtained showed that the increase of harvest caused by the fertilizer reduced the amount of manganese taken out of the soil. It was suggested that the fertilizer should be supplemented by manganese in order to maintain a good harvest. (NSA)

<35>

Ananyan, V.L., and G.S. Sarkisyan, Effect of Fertilizers on the Accumulation of Calcium and Radiostrontium in the Alpine and Subalpine Meadow Plants. 1971. Dokl. Akad. Nauk Arm. SSR, 11, 61-73 (Soobshch. Inst. Agrokhim. Probl. Gidropniki, Armenia, USSR)

Experiments of many years (1962 to 67) were carried out to study the effect of fertilizers

and lime on the accumulation of Ca and Sr 90 and their ratios in alpine (Mt Aragatz) and subalpine (Mt Aragatz and Gegham mountain ridge) meadow plants growing in beds with sizes of 1.56 to 2.8 cm with up to 4 to 6 repetitions. Of the various experimented fertilizers, (N, PK, NP, NK, NPK) from the point of view of plant productivity and the decrease of specific content of Sr 90, NK and NP are considered to be promising in the alpine and subalpine zones. Results obtained from NPK are contradictory. Liming together with mineral fertilizers show a positive effect in the alpine zone. Liming helps the ratio of Sr 90/Ca in the plants to be diminished. (Auth)

<36>

Andelman, J.B., and T.C. Rozzell, Plutonium in the Water Environment. I. Characteristics of Aqueous Plutonium. 1970. Advan. Chem. Ser., 93, 118-137; Part of Proceedings of a Symposium on Radionuclides in the Environment held in San Francisco, California, April 1, 1968 (University of Pittsburgh, Pittsburgh, PA)

In the pH range of natural waters colloidal plutonium (+4) hydroxide forms from polymeric hydrolysis products and ages slowly. At least over a period of several days an increase in particle sizes is observed. At pH 7 such solutions aged for a few months showed a significant increase in size of the colloidal plutonium as the ionic strength increased from 0.002 to 0.1. The centrifugability of the colloid, aged for three and seven days at pH 7, decreased for plutonium concentrations less than 10(E-7) M. The addition of macroscopic grains of crystalline silica affected the colloidal plutonium size distribution as did the variation in pH over the range of 5 to 8. The addition of 10(E-2) M bicarbonate ions at pH 7 also influenced the distribution but less systematically. (Auth)

<37>

Andersen, A.J., Plant Accumulation of Radioactive Strontium with Special Reference to the Strontium-Calcium Relationship as Influenced by Nitrogen. 1973. NISO-278; 56 p. (Not given)

The report summarizes and discusses a series of investigations on the plant uptake of radioactive strontium. The influence of plant species, soil types, cultivation practices, liming and mineral fertilization are discussed. Special emphasis has been paid to the effects of nitrogen since it was shown that nitrogen fertilization increased in oats the uptake of strontium and of the homologous element calcium in oats. Associated with the increased uptake was a change in the discrimination between the two elements (Sr and Ca) so that the Sr/Ca ratio in grains of oats decreased relative to the ratio in the vegetative parts of the plants. (Auth)

<38>

Andersen, A.J., Effects of Nitrogen Nutrition on the Uptake, Distribution, and Chemical Binding of Strontium and Calcium in Oat Plants. 1972. NISO-256; (p. 177-186) (Not given)

The uptake of added radioactive Sr and Ca increased almost linearly with increasing supply of NH₄NO₃ to the soil. The Sr 85/Ce 45 ratio varied between plant parts being lower in leaves, glumes, pales and grain than in stems and flower stalk. This indicates that discrimination against Sr 85 relative to Ca 45 occurs during transfer of the two ions from the conducting system. The compounds of

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stronger chemical bindings contained more Sr 85 than Ca 45. This may explain some of the discrimination against Sr 85 during transport of the two ions within the plants, but it cannot account for the very low Sr 85/Ca 45 ratio obtained in grain with high N supply. An active, N-dependent discriminatory mechanism is assumed to regulate the transfer of Sr and Ca to oat grain. (Auth)

<39>

Andersen, A.J., Investigations on the Plant Uptake of Fission Products From Contaminated Soils. II. The Uptake of Radioactive Strontium Placed at Different Depths in the Soils. 1967. RISO-174; 19 p. (Danish Atomic Energy Commission, Risoe Research Establishment, Roskilde, Denmark)

The possibility of reducing the plant accumulation of Sr 90 by deep ploughing of the contaminated soil was investigated in experiments with different crops grown in microplots. The Sr 90 was placed at different levels in the soil profile, and the uptake by barley, rye-grass, red clover, and root crops was measured. As compared with superficial application, placement of strontium at a depth of 40 to 45 cm reduced the Sr 90 content of the crops by a factor of two to five according to the soil type. Placement at a depth of 80 to 85 cm as compared with 40 to 45 cm caused only a very small difference in the uptake. The downward movement of the Sr 90 was very slow. Almost all the strontium remained within the 20 cm soil layer in which it was applied. (Auth)

<40>

Andersen, A.J., Investigations on the Plant Uptake of Fission Products From Contaminated Soils. I. Influence of Plant Species and Soil Types on the Uptake of Radioactive Strontium and Cesium. 1967. RISO-170; 32 p. (Danish Atomic Energy Commission, Risoe Research Establishment, Roskilde, Denmark)

Results of pot experiments on the uptake of radioactive Sr and Cs by different plant species are presented, and comparisons are made between the uptake figures registered on some representative Danish soils. The uptake of radioactive Sr varied considerably between plant species and could be evaluated from their Ca uptake. The Sr 89/Ca ratio varied between different parts of the same plant, being relatively high in the roots of root crops and low in seeds and fruits. The Sr 89 uptake from different soil types decreased with increasing content of exchangeable Ca in the soils. The Cs 137 uptake varied between plant species and could be reduced by potassium fertilization. The uptake from different soil types generally decreased with increasing clay content, but also the content of organic matter influenced the plant availability of Cs 137. (Auth)

<41>

Andersen, A.J., Uptake by Plants of Radiostrontium from Contaminated Soils. 1965. Nature, 208, 195-196 (Danish Atomic Energy Commission, Agricultural Research Department, Risoe, Roskilde, Denmark)

The effect of phosphate, calcium, and firing of the soil reaction products were evaluated as to uptake of radiostrontium by barley. (CWF)

<42>

Andersen, A.J., Influence of Phosphorus and

Nitrogen Nutrition on Uptake and Distribution of Strontium and Calcium in Oat Plants. 1971. Soil Science Society of America Proceedings, 35, 108-111 (Danish Atomic Energy Commission, Agricultural Research Department, Risoe, Roskilde, Denmark)

The influence of phosphorus and nitrogen applications on the uptake of radioactive strontium and calcium by oats was studied in pot experiments. Heavy applications of phosphorus decreased the concentrations as well as the total uptake of strontium 90 and calcium, but the strontium 90/Ca ratio was little affected. Nitrogen additions increased the uptake of stable Ca more than that of strontium 90 so that the Sr 90/Ca ratio based on total uptake decreased with increasing N supply. The results indicate that translocation of Sr and Ca as well as their uptake may be differentially influenced by N nutrition. (Auth)

<43>

Andersen, A.J., Influence of Nitrogen Nutrition on the Discrimination Between Strontium and Calcium in Oat Plants. 1971. CONF-711213; IAEA/SN-151/12; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on the Soil-Plant Relationships Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971 (Danish Atomic Energy Commission, Agricultural Research Department, Risoe, Roskilde, Denmark)

The influence of nitrogen on the differential uptake of strontium 85 and calcium 45 depended on the soil properties as well as the nutritional status of the plants. (CWF)

<44>

Andersen, A.J., The Uptake and Distribution of Strontium in Oat as Influenced by the Time of Supply. 1971. Soil Science, 111, 379-381 (Danish Atomic Energy Commission, Agricultural Research Department, Risoe, Roskilde, Denmark)

Oats were grown in culture solution in which the uptake of radiostrontium was measured at various time of plant development. Data indicate that the radiostrontium is taken up rapidly and transported to the growing plant part and incorporated into the tissue. Redistribution of the radiostrontium on subsequent plant growth is minimal. (CWF)

<45>

Andersen, A.J., Influence of Liming and Mineral Fertilization on Plant Uptake of Radiostrontium from Danish Soils. 1963. Soil Science, 95, 52-59 (Danish Atomic Energy Commission, Agricultural Research Department, Risoe, Roskilde, Denmark)

The uptake of radioactive strontium from 20 Danish agricultural soils was studied under greenhouse conditions using ryegrass and red clover as test crops. Various forms of calcium were evaluated as to their influence on radiostrontium uptake by plants. Applications of lime at 2.5 tons per hectare showed little effect on uptake of radiostrontium, but heavy amounts (5-10 tons/ha) reduced radiostrontium uptake from acid soils. (CWF)

<46>

Andersen, A.J., G. Gissel-Nielsen, and G. Nielsen, Effects of Fertilization on the Strontium-Calcium and Cesium-Potassium Relationship in Plants. I. The Uptake and

<46> CONT.

Distribution of Radioactive Strontium and Calcium in Oats.. 1967. Kongelige Veterinar-og Landbohøjskole, Årskrift, 154-167 (Danish Atomic Energy Commission, Agricultural Research Department, Bisce, Roskilde, Denmark)

The influence of fertilization on the uptake of radioactive strontium relative to calcium by oats was investigated in pot experiments. The effects of increasing amounts of magnesium sulphate combined with increasing amounts of potassium sulphate were measured on a coarse sandy soil, and the effects of increasing amounts of ammonium sulphate, likewise combined with different amounts of potassium sulphate, were measured on a sandy clay loam and a sandy loam. The magnesium fertilization reduced the calcium uptake to a higher degree than the strontium uptake, which resulted in increased strontium 89 to calcium ratios in the straw, but not in the grain. The effects of potassium varied with soil type and nutrient content in the soil. The strontium uptake from all the soils was reduced by adding potassium, and the calcium uptake from the two loamy soils was reduced, but not from the calcium-poor coarse sand. Both the strontium 90 and the calcium uptake were appreciably increased by nitrogen fertilization, but the two ions were not equally affected. The strontium 90 to calcium ratio, based on total uptake, varied with the treatments. At low and moderate potassium levels this ratio decreased with increasing nitrogen amounts, whereas no effects of nitrogen could be seen at the highest potassium level. The ratio of strontium 90 to calcium was decreased in both grain and straw by nitrogen application, but the decrease was most pronounced in the grain, which is demonstrated by the decreasing DF straw-grain values. A similar effect was obtained by adding calcium nitrate and urea. (Auth)

<47>

Andersen, A.J., and W.A. Jackson, Influence of Nitrogen Supply on Uptake and Translocation of Strontium and Calcium in Wheat Seedlings. 1972. Physiologia Plantarum, 26, 175-181 (Not given)

Supplying nitrate to N-depleted wheat seedlings stimulated the uptake and translocation of both Sr 85 and Ca 45. Since the increase in Ca 45 accumulation was greater, the Sr 85/Ca 45 ratio in the plant tissue was decreased. Nitrate had relatively little influence on the amount of the divalent cations and Sr 85/Ca 45 ratio in the exchangeable fraction on the root surfaces, whereas it greatly increased the uptake into root tissue and translocation to shoots. Ammonium and urea also increased the translocation of the two cations, indicating that the effects of nitrate could not entirely be ascribed to a direct effect of the nitrate anion. (Auth)

<48>

Andreev, A.G., V.S. Komarov, A.P. Lopatkina, and A.N. Sergeev, Evaluation of the Ages of Uranium-Bearing Hydromorphic Soils from the Accumulation of Thorium 230. 1969. Geochem. Int. (Engl. Transl.), 6, 580-584; Geokhimiya, 6, 724-728

Hydromorphic soils of high uranium content may be dated by the U/Th 230 method if: the age of the uranium accumulation is the same as that of soil formation; allowance can be made for the Th 230 content of the soil-forming water; and there is no migration of U or Th beyond the accumulation area. The ages of

shallow hydromorphic soils in three areas in East Siberia are between 1600 and 2800 years, in agreement with carbon 14 ages. (Auth)

<49>

Anochin, V.L., Ju.M. Sviridov, and A.N. Tjurukanov, Mathematical Model for Migration of Radiostrontium in Soil. 1967. CONF-660405; Part of Aberq, B. and Hunkate, P.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, (p. 43-51), 1051 p. (Academy of Sciences, Computing Centre, Ukrainian, SSR, USSR)

A mathematical model describing the movement of radiostrontium through a soil profile is presented. (CWF)

<50>

Anspaugh, L.R., P.L. Phelps, and G.W. Hunkabay, Methods for the In Situ Measurement of Radionuclides in Soil. 1972. HASL-269; (p. 12-38) (Not given)

The feasibility of using a Ge(Li) detector in the field to quantify radionuclides contained in soil was demonstrated. In addition a generalized computer code was developed for application to a variety of detector geometries and source distributions. Very small differences, i.e., 2% for K 40, were noted in radioactivity levels for the natural occurring radionuclides as measured by the in situ Ge(Li) method and laboratory analysis. The discrepancy in results for Cs 137 however was larger and probably was related to inadequate soil sampling over too small an area. Work is presently underway to better understand the problem. (Auth)

<51>

Antropova, Z.G., E.I. Belova, I.G. Vodovozova, and V.A. Baturin, Some Peculiarities of the Behavior of Radioactive and Stable Strontium in Meadow Biogeocoenoses. 1971. Radiobiologiya, 11, 301-304 (Institute of Biophysics, Ministry of Health, Moscow, USSR)

The results obtained show that the content of strontium 90 in the grass of natural fodder areas depends chiefly on the nature and structure of the sod, the floral composition of the stand of grass and, to a lesser degree, on the physicochemical properties of the soil. At the tenth year of the presence of strontium 90 in soil, its distribution among the components of meadow biogeocoenoses becomes analogous to the distribution of stable strontium. (Auth)

<52>

Archer, V.E., S.C. Black, W.C. Dixon, and G. Saccomanno, Urine and Tissue Content of Lead 210 and Polonium 210 in Uranium Miners. 1967. Part of Kornberg, H.A. and Norwood, W.D. (Eds.), Diagnosis and Treatment of Deposited Radionuclides, Proceedings of a Symposium held at Richland, Washington, May 15-17, 1967, (p. 553-572) (U.S. Department of Health, Education, and Welfare, National Center for Urban and Industrial Health, Salt Lake City, UT)

Urine and tissue samples from uranium miners were analyzed for Po 210 and Pb 210. In urine samples obtained within a short period after exposure, there was a relationship between the exposure and both Po 210 and Pb 210 content of urine. In urine samples obtained some time after exposure, the Po 210 and Pb 210 content

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of urine showed better correlation with cumulative exposure to radon daughters. Tissues having the highest concentrations of Po 210 and Pb 210 were bone, kidney, lung, hilar lymph nodes, hair and liver. In most tissues there was slightly more Pb 210 than Po 210, but in kidney, liver and hair this relationship is reversed. There appears to be a change in the ratio between bone content of Po 210 and Pb 210 and that of soft tissue as the interval between last mining and tissue analysis is lengthened. Possibilities of using radiation exposure in mines are discussed. There are currently two deterrents to this use: the time and difficulties involved in present methods of analysis and the lack of a satisfactory quantitative correlation between exposure and analytical results. (Auth)

<53>

Argiero, L., and G. Barzon, Absorption of Elements by Clays. 1970. CONF-690918-(Vol. 1): Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 655-664), 684p. (CAMEN, Pisa, Italy)

The ion exchange capacity and the distribution coefficient for the elements Ru, Cs, and Ce were studied on several clays. Four groups of samples of quaternary sediments and three groups of Pliocene sediments were examined. The difference between the exchange capacities of these two types of samples seems to be due to the presence of a vermiculite-type material in the quaternary soil. Another peculiarity observed is the aspect of the distribution coefficients, which increase rapidly while the C_i value of the initial concentration of the radioisotopes studied decreases. (Auth)

<54>

Argiero, L., G. Del Corso, S. Manfredini, and G. Palmas, Sorption and Distribution of Strontium 90 and Cesium 137 in the Wheat from a Contaminated Soil. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962, (p. 161-169) (CAMEN, Pisa, Italy)

In order to study the sorption of Strontium 90 and Cesium 137 by wheat at different stages of growth, some seeds were sown in little cases filled with earth materials containing various quantities of Ca and K. At different stages of growth, the earth materials containing various quantities of Ca were contaminated with Sr 90, the earth materials containing different quantities of K were contaminated with Cs 137. Plant samples were taken at different stages of their growth, and their radioactivity was measured. (Auth)

<55>

Arkhipov, N.P., A.V. Yegorov, and V.M. Klechkovskii, Quantitative Estimation of the Strontium 90 Intake by Plants from the Soil and Its Accumulation in Crops. 1969. A-AC-82/G/L-1290; AEC-tr-7128; Part of USSR Reports on Natural and Fallout Radioactivity, (p. 143-151) (State Committee on Utilization of Atomic Energy, Moscow, USSR)

Correlation data of strontium 90 in various agricultural plants grown on a number of soil types over a 7 year period is presented. Correlation coefficients were found to be highest when the strontium 90 content in the harvest is compared with strontium 90 levels

in the soil normalized with respect to calcium. (CWF)

<56>

Armstrong, N.E., Numerical Solutions of Radionuclide Transport Equations and Role of Plants in Strontium 85 Transport. 1968. Ph.D. Thesis; 153 p. (University of Texas, Austin, TX)

The role of plants in Sr 85 transport in aquaria and a model river was examined, and a numerical solution to the dispersion equation with convection was derived and extended to include plant sorption. Using the macrophyte, *Vallisneria spiralis* Michx., it was found that almost instantaneous equilibrium was reached with Sr 85 in solution through adsorption followed by a slower and more complete uptake by adsorption. A characteristic pattern of uptake and release was observed after instantaneous releases into both aquaria and at stations downstream from the point of release in a model river. Under continuous release, uptake tended toward an equilibrium level, which was a function of the amount of attached algae present. It was concluded for conditions used in this study that plants played a negligible role in Sr 85 transport. The uptake of Sr 85 by plants after instantaneous release could be modeled using a sorption-desorption equation. Instantaneous dye and Sr 85 releases were made in the model river to determine the dispersion coefficient and tracer cloud velocity with the two station method using only a selected portion of the concentration-time curves. The best cut-off point for this portion was the point where one-tenth the peak value was observed. Solutions of the numerical model using constants calculated in this manner gave better fit to the observed data than methods previously used. Constant release data could also be predicted with this model using revised initial conditions. A numerical solution to the equations relating dispersion to plant uptake was also derived but not extensively tested. It was concluded that numerical solutions may hold more promise in this area than analytical solutions because of their versatility and ease of computation. (Auth)

<57>

Athalye, V.V., and K.B. Mistry, Foliar Retention, Transport and Leaching of Polonium 210 and Lead 210. 1972. Radiation Botany, 12, 287-290 (Bhabha Atomic Research Centre, Bombay, India)

Polonium 210 and lead 210, the long-lived daughter radionuclides of gaseous radon 222, are deposited on plant surfaces under conditions of atmospheric washout. Foliar retention, transport and leaching of these radionuclides in Red Kidney Beans were investigated in nutrient culture experiments. Under identical conditions, over 90% of foliar applied radiolead was retained by the plant while only about 30% of polonium was retained. Over a 48-hr period small quantities of polonium were translocated from the treated leaflet to other parts of the plant. By comparison, radiolead was totally immobilized at the site of retention. Leachability of root absorbed radiolead from bean leaves was 20-fold greater than that of polonium. The marked differences in the extent of foliar retention, translocation and leaching of polonium and radiolead could significantly affect the levels of these long-lived radionuclides attained in plants. (Auth)

<58>

Athalye, V.V., and K.B. Mistry, Uptake and Distribution of Polonium 210 and Lead 210 in Tobacco Plants. 1972. Radiation Botany, 12, 421-425 (Bhabha Atomic Research Centre, Bombay, India)

The uptake and distribution of polonium 210 and its long-lived precursor lead 210 in two flue-cured tobacco varieties (NICOTIANA TABACUM L. cv. Delcrest and cv. Virginia gold), were examined in nutrient culture experiments. The accumulation of these radionuclides was greatest in the roots. Over identical durations of growth, the extent of upward transport of Po 210 and Pb 210 was relatively greater in cv. Virginia gold. The distribution of the radionuclides in aerial tissues followed an acropetal gradient suggesting that Po 210 and Pb 210 concentrations in leaf tobacco used for cigarette production would be reduced if leaves other than the oldest pairs are harvested. (Auth)

<59>

Athalye, V.V., and K.B. Mistry, Studies on the Uptake and Transport of Radiostrontium in Plants. 1971. CONF-701227; Part of Proceedings of a Symposium on Radiation and Radioisotopes in Soil Studies and Plant Nutrition held in Bangalore, India, December 21, 1970. Department of Atomic Energy, Bombay, India. (p. 127-142) (Bhabha Atomic Research Centre, Bombay, India)

Seedlings of beans (PHASEOLUS VULGARIS) were grown in polyethylene jars containing culture solutions. Strontium 89 was administered to three-week old plants and accumulation factors were calculated; the time course of uptake by roots and shoots is shown by means of graphs. A table is presented to show distribution of Sr 89 in roots, stems, and leaves. Data from the literature on Sr 89 uptake by barley, maize, and peas was used for comparison with experimental data and a table is presented to show species effects. Effects of variations in pH and salt concentrations and effects of metabolic inhibitors on Sr 89 uptake in beans were also investigated and results are tabulated. (NSA)

<60>

Auerbach, S.I., The Soil Ecosystem and Radioactive Waste Disposal to the Ground. 1958. Ecology, 39, 522-529 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Ecosystem concept is applied to soils. A good review of the literature concerning movement of radionuclides in soils is presented. Some data is presented concerning exposure of arthropod populations to various doses of gamma radiation. (CWF)

<61>

Auerbach, S.I., and D.A. Crossley, Jr., Strontium 90 and Cesium 137 Uptake by Vegetation Under Natural Conditions. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 494-499), 624 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

Data is presented relating to the quantities of strontium 90 and cesium 137 found in natural plant vegetation growing in the lake bed of a drained radioactive waste impoundment (White Oak Lake). The quantity of fission products extracted by commonly used soil

extraction procedures relative to that taken up by the plants is discussed. (CWF)

<62>

Auerbach, S.I., S.V. Kaye, D.J. Nelson, D.E. Reichle, P.B. Dunaway, and R.S. Booth, Understanding the Dynamic Behavior of Radionuclides Released to the Environment and Implications. 1971, September. CONF-710901; A/CONF-49/P-85; Part of Proceedings of the Fourth International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 6-16, 1971, 18 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

The environmental behavior of radionuclides released to aquatic and terrestrial ecosystems from both routine plant operations and tracer experiments at Oak Ridge National Laboratory (ORNL) has been studied by ecologists during the past 15 years. Two important aspects of these continuing studies are: (1) radionuclides used as tracers in the environment help to delineate complex ecological processes and (2) radiolabels quantifying rate processes provide primary ecological information for developing dynamic models of radionuclide transfers to man. Systems analysis techniques are being used to simulate the environmental behavior of radionuclides. Chronic releases of small quantities of radionuclides to White Oak Lake and the Clinch River have provided a unique case study of the environmental behavior of several radionuclides. Radionuclides occurring regularly in organisms from White Oak Lake include Sr 90, Cs 137, Co 60, and H 3. Occasionally Ru 106, Sb 125, and Zn 65 are found. Because of dilution, only Sr 90 and Cs 137 are found regularly in the Clinch River. Coupling of field and laboratory data on selected radionuclides in fish, aquatic insects, mollusks, and crustaceans provides the necessary parameters for dynamic models of radionuclide movements in aquatic ecosystems. Research in terrestrial ecosystems has emphasized the biogeochemical cycling of fission products in forest, grassland, and old field ecosystems. Radionuclide dynamics (Co 60, Sr 90, Sr 95-Nb 95, Ru 106, Cs 137, and Ce 144) in natural plant communities have been followed where soil reaction products have formed. Plant translocations and food-chain studies with Na 22, K 42, Ca 45, Rb 85, I 131, and Cs 137 have detailed pathways and fluxes of additional radionuclides in these ecosystems. Research has provided insight into the budgets and turnover times of major nutrient elements and potentially hazardous radionuclides in contrasting ecological systems. Fifteen years of environmental research at ORNL strongly suggests that the dose necessary to evoke an unequivocally detectable biological response is considerably greater than that resulting from maximum permissible concentrations in the environment. (Auth)

<63>

Auerbach, S.I., and J.S. Olson, Biological and Environmental Behavior of Ruthenium and Rhodium. 1963. Part of Proceedings of the National Symposium on Radioecology, 1963. Reinhold Publishing Corporation, New York, (p. 509-519) (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Many analytical and physiological data have been taken to imply a low biological availability of ruthenium and rhodium. Yet ruthenium 103 and Ru 106-Rh 106 must be considered among the more important environmental contaminants because of their

<63> CONT.

relatively high yield from fission and their moderately long half-lives. Experiments involving waste effluents and nitrosyl compounds of ruthenium, which are formed in the common types of radioactive waste, have shown that these compounds may be taken up in greater quantities or behave differently when released into environmental situations. These differences in behavior, which may be attributable to the various chemical forms of ruthenium, impose a need for further investigations, particularly of a comparative nature, which take these complex forms into account. Regardless of origin, the instability of ruthenium compounds in changing environments will require the utmost care in interpretation of biological and environmental behavior of ruthenium. (CWF)

<64>

Auerbach, S.I., J.S. Olson, and H.D. Waller, Landscape Investigations Using Cesium 137, 1964. Nature, 201, 761-764 (Oak Ridge National Laboratory, Health Physics Division, Radiation Ecology Section, Oak Ridge, TN)

Cesium 137 was innoculated into selected trees of a second-growth yellow (tulip) poplar (LIRIODENDRON TULIPIFERA L.) forest to investigate ecological processes in the landscape. (CWF)

<65>

Auraldsson, H.A., A. Eriksson, and U. Greitz, Transfer of Radiostrontium from Pasture to Milk. 1970. FOA-4-4445: 18 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The transfer of radiostrontium from pasture to milk was studied in field experiments performed in 1968 and 1969. Sr 85 in water solution was sprayed onto the surface of a fenced pasture. Ten cows were brought there for a three days grazing period and then onto uncontaminated pasture. The concentration of Sr 85 in the milk and the milk production from each cow was measured twice a day. The experiment was performed three times in an essentially identical way. It was found that the concentration in milk following an initial deposition of 1 uCi/m² on grassland amounted to about 0.03 uCi/l. It was attempted to assess the fraction of deposited Sr 85 retained on the edible herbage consumed by the cows. The cows were given an oral single dose to establish the relation between intake and milk content. From this relation the intake per cow when grazing on contaminated pasture could be calculated. It was found that the fraction of Sr 85 which was retained on the edible herbage consumed by the cows was on the average 40 percent. This percentage corresponds fairly well to the retention factor found for world wide fallout particles. (Auth)

<66>

Awschalow, M., T.B. Borak, and W. Fairman, Underground Water Leaching of Radionuclides Produced in Scil by Hadrons Created in High Energy Proton Interactions. 1971. Trans. Nucl. Sci., 18(3), 739-740; CONF-710308; Part of Proceedings of a National Particle Accelerator Conference held in Chicago, Illinois, March 1-3, 1971 (National Accelerator Laboratory, Batavia, IL; Institute Elec. Electron., England)

Soil samples collected from the NAL construction site were irradiated downstream from Target stations at the Argonne National

Laboratory ZGS and Brookhaven National Laboratory AGS. Radiochemical analyses were performed to determine the radioactivities induced in the soil. Batch-type leaching experiments were then conducted to determine the distribution of the induced radionuclides between the soil and water. Of the radionuclides produced in the soil, only H 3, Na 22, Ca 45 and Mn 54 were detected in the leach waters. The results were used to determine possible contamination of underground reservoirs. (Auth)

<67>

Aziz, A., and M.A. Huharuk, Ion Exchange Properties of PINSTECH Soil for the Disposal of Liquid Radioactive Waste Directly into the Ground. 1968. PINSTECH/HP-7; 30 p. (Pakistan Institute of Nuclear Science and Technology, Islamabad, Pakistan)

Soil characteristics, e.g., type, ion exchange/adsorption capacity for some radionuclides with and without the presence of competing ions, and leaching of adsorbed ions on the H(+) ions were investigated. The ion exchange capacity of the soil was found to be between 5 to 7 mequiv/100 gm soil. The adsorption of radioactive trace ions on the soil was inhibited by the presence of competing ions. The degree of inhibition was more for higher concentration of competing ions and their higher ionic charge. Solutions such as 1 M NH₄Cl and 0.1 M HNO₃ leached away almost all cesium, strontium, and cobalt ions from the soil. Dilute acidic solutions leached the adsorbed ions depending on the H(+) ion concentration in the solution. Characteristics of PINSTECH site, e.g., geography, climate, sub-soil geology, are discussed from the point of view of the safe disposal of liquid radioactive wastes into the ground. It was concluded that the disposal of low level liquid waste at PINSTECH into shallow pits in the ground is an economic and safe method of disposal. It was estimated that a total of about 8.5 million imperial gallons per year of low level liquid waste can be disposed of from a pit measuring 100 ft x 50 ft x 5 ft which would cost only \$400. (Auth)

<68>

Babcock, K.L., R. Handley, and R.K. Schulz, Behavior and Effects of Radionuclides in Soils and Plants. 1972. UCB-34-P-23-X-4; 70 p. (University of California, Department of Soils and Plant Nutrition, Berkeley, CA)

The uptake of Sr by the excised roots of corn (ZEA MAYS L. var. Golden Cross Bantam) involves a metabolic accumulation mechanism which appears to be the same as that responsible for K uptake. Although K interferes seriously with the accumulation of Sr the reverse is not true; only stimulatory effects upon K uptake were observed. Non-metabolic (physical) uptake of Sr comprises a large fraction of the total. This fraction is relatively insensitive to K. Calcium interferes much less than K with Sr uptake. The effects of K and Ca on the uptake and distribution of Sr and Cs in whole corn plants have been investigated. The inhibitory effect of K upon uptake of Sr by excised roots applies equally to whole plants. However, this inhibition of Sr uptake is accompanied by a relatively greater transport of Sr from root to shoot. Strontium, metabolically absorbed by the corn root, is fairly labile and available for upward transport. Calcium as in excised roots, inhibits total uptake slightly but significantly increases retention by the root. Uptake of carrier-free Cs 137 by intact

<68> CONT.

tomato leaf samples was found to be extremely variable. The variability appears to be related in large part to the age of the tissue. To counter this variability, an experimental procedure was adopted based on analysis of the ambient solution which permits uptake by a single sample to be observed over a lengthy experimental period. The results so far obtained have not demonstrated any involvement of a metabolically driven mechanism with Cs uptake. The amounts of Cs 137 taken up in ten hours at 0 C are essentially equal to those taken up at 26 C. The forms of the curves plotting uptake vs. time at the two temperatures are, however, greatly different. The rate of uptake at 0 C is constant over a 10-hr period. Uptake at 26 C is initially faster than at 0 C but the rate slackens after about four hours. Possible reasons for this are discussed. Urea, which has been shown to promote the absorption of phosphate and organic compounds in whole leaves, had an inhibitory effect on uptake of Cs 137. (Auth)

<69>

Bache, B.W., Barium Isotope Method for Measuring Cation-Exchange Capacity of Soils and Clays. 1970. J. Sci. Food Agr., 21, 169-171 (Macaulay Institute for Soil Research, Aberdeen, Scotland)

Cation-exchange capacity has been measured by isotopic exchange of Ba 133 with Ba(+2)-saturated soils and clays in 2.5 x 10 (E-3) M-BaCl₂ suspensions. The rate of isotopic dilution, the efficiency of displacement of soil cations by Ba(+2), and the precision of the method are critically assessed. The method is reliable and convenient, and can be used with both buffered systems. (Auth)

<70>

Baetsle, L., Physicochemistry of Cation Migration in the Ground. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium)

The present studies led to the development of new methods allowing investigation of the variation of the distribution coefficient in a natural ion exchanger occupied by three macroscopic ions. The research will be continued in order to arrive at an analytical expression between the physicochemical variables i.e. the selectivity coefficients and the equilibrium constants. The determination methods of the relative velocities of radioactive cations in soils have been investigated comparatively. No definite method has been found for the case of continuous discharge into the ground. For the migration of radionuclides in a natural environment the calculation method based on the static distribution coefficient seems to be adequate. Hence the analogy between the hydrodynamic and physicochemical dispersion is examined in order to determine the relation between the parameters describing the phenomena. Finally some practical cases are presented and commented upon. (Auth)

<71>

Baetsle, L., Computational Methods for the Prediction of Underground Movement of Radionuclides. 1967. Nuclear Safety, 8, 576-588 (Belgian Nuclear Research Center, Radiochemical Research and Chemical Analysis Service, Belgium)

A comprehensive and critical review is

presented of the computational methods for use in predictions of underground movement of radionuclides. (CVF)

<72>

Baetsle, L., P. Dejonghe, W.F. Maes, and P.I. Staner, Present Status of the Study Program on the Movement of Radionuclides in the Soil at Mol. 1963. EURAEC-416; EUR-140.f; 41 p. (Societe Belge de Chimie Nucleaire, Brussels, Belgium)

The consequences of an accidental discharge of radionuclides into the soil were predicted and an evaluation was made of the reception capacity of the soil for solid materials with a known solubility and elution degree. This program consisted of two essential parts and more specifically of the study of the water movement in the soil and the influence of retention due to the soil materials on the transportation of radionuclides by the water. Regarding the study on the water movement it has been stated that micromethods should be elaborated in order to measure the direction and the flowrate on a determined spot instead of using approximating values for a larger region. For this reason injection methods of radiotracers and sampling of the ground water were developed on a micro scale. In one case samples were taken by lowering copper rods or sheets which were activated by chemisorption of the radiotracer. Equipment for direct soil- and ground water sampling was developed. A thorough study was carried out on the retention phenomena of radionuclides by sorption on the earth materials. This study led to the determination and calculation of relative velocities. Finally for the Mol site a first evaluation of the storage capacity has been made for materials with known solubility and containing Cs 137 and Sr 90. Relatively important injections into the soil of Strontium 89 and Cs 137 were prepared in order to verify the agreement between theory and field observation. (Auth)

<73>

Baetsle, L., and W.F. Maes, Radioisotope Migration in Soil. 1964. Pedologie, 14, 205-227 (Centre d'Etude de l'Energie Nucleaire, Brussels, Belgium)

The migration of radionuclides in soils may be described by two easily determinable parameters; the distribution coefficient and the dispersion coefficient. Studies of ionic equilibria in soils have led to the formulation of the distribution coefficient ($K_d: ml/g$) which is directly related to the velocity of the migration of the radioelements in soils. The degree of dispersion of migration radionuclides in porous media can be expressed quantitatively by the dispersion coefficient ($D: cm^2/sec$), which takes into account the physical characteristics of the medium and the phenomena due to molecular diffusion. Longitudinal as well as transversal dispersion is discussed. From the undertaken investigations it appears that in isotropic porous media and at low migration velocity a moving point source transfers into a spherical cloud and into a ellipsoid when velocity rises, injections with radionuclides in nature have confirmed the above conceptions. (Auth)

<74>

Baetsle, L., W.F. Maes, J. Souffriau, and P.I. Staner, Migration of Radionuclides in Soil, Final Report. 1966, March. EUR-2481.f; 66 p. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium)

<74>

<74> CONT.

Meteorologic and hydrologic observations at the Mol site were studied and led to a correlation between both phenomena. From these data the recharge rate of the aquifer and the real infiltration velocities were computed. A new device called Multicounter was developed for the in situ measurement of ground water velocity and direction in non-consolidated media. The apparatus is made of a stainless steel cylinder with four counter tubes piercing the bottom plate. The activities of the four counters are recorded simultaneously and provide Activity-Time plots which characterize the movement. Fundamental studies on the nature of the dispersion phenomena showed the existence of two distinct mechanisms being mainly influenced by the molecular diffusion. The dispersion coefficients vary between 10 E-3 and 10 E-5 cm²/sec for velocities ranging from 10 E-2 to 10 E-4 cm/sec. Two techniques were developed in order to increase the soil's retention capacity for Sr 90. The first one is based on the introduction of lignite treated with K₄Fe(CN)₆ + FeCl₃, and the other consists of a treatment with HF followed by K₂H₂Sb₂O₇. Both "chemical barriers" catch all the Sr 90 found in 200 and 60 volumes, respectively flowing through the barrier. (Auth)

<75>

Baeva, A.I., and A.B. Akhundova, Uranium Content in Various Types of Plants in the Subtropical Lenkoran Region of Azerbaidzhan SSR. 1970. Dokl. Akad. Nauk Azerb. SSR, 26, 5, 69-71 (Institute of Soil Studies and Agrochemistry, Baku, USSR)

Natural radioactivity produced by cosmic radiation from rocks and plants was studied in the subtropical zone in a dry-field region of Nakhichevan, Azerbaidzhan SSR. It was observed that all higher plants examined exhibited a higher beta radioactivity than alpha. Results of 120 analyses of various plants for uranium content in various organs showed a variation of $7.3 \times 10(E-6)$ to $8.5 \times 10(E-5)$ percent. In ashed oaks (QUERCUS sp) the U in leaves was lower than in branches. In bilberry (VACCINIUM sp) and dewberry (RUBUS sp) bushes, the content of U varied from $2.8 \times 10 E-5$ to $2.0 \times 10 (E+3)$ percent. The content of U in ashed samples depended mostly on the location or type of plant. (NSA)

<76>

Bagliano, G., S. Fratarcangeli, M.G. Lalli, and I. Toeroek, Measurement of Cesium 137 and Strontium 90 in Soil. 1972, March 30. RT/PROT-72-11; 27 p. (Comitato Nazionale per l'Energia Nucleare, Rome, Italy)

An analytical method is described for determination of Sr 90, Ca, Cs 137, and K in soil samples of different chemical composition. Also reported are the results of analysis performed on 30 soil samples taken at several different sampling points. (Auth)

<77>

Baker, D.E., A New Approach to Soil Testing. 1971. Soil Science, 112, 381-391 (Pennsylvania State University, University Park, PA)

The availability of potassium and magnesium from soil was determined directly by measuring the changes in concentrations of the respective ions in a 1:10 soil to solution ratio of standardized solutions of potassium, magnesium, and calcium chloride. (CWF)

<78>

Baker, D.E., R.R. Bradford, and W.I. Thomas, Accumulation of Calcium, Strontium, Magnesium, Phosphorus and Zinc by Genotypes of Corn (ZEA MAYS L.) under Different Soil Fertility Levels. 1964. NYO-2744-37; CONF-660912-1; Part of Proceedings of the FAO/IAEA Symposium on the Use of Isotopes in Plant Nutrition and Physiology Studies, held in Vienna, Austria, September 5-9, 1966 (Pennsylvania State University, Department of Agronomy, University Park, PA)

Single-cross hybrids were selected for investigation on the basis of the chemical element accumulation characteristics of the parental inbred lines in other single-cross hybrids (CWF)

<79>

Baker, J.H., W.A. Beeten, and J.S. Wahiberg, Adsorption Equilibria Between Earth Materials and Radionuclides. 1961, July. PNE-481; (p. 1121-1139) (U.S. Geological Survey, Menlo Park, CA)

The concept and the derivation of a distribution coefficient are developed. Ion exchange and the nature of competition among cations are discussed. Distribution coefficients for carrier-free cesium, strontium, and iodine were determined on 17 soil samples collected during July 1961 in the vicinity of Cape Thompson. High percentage uptake of these ions was measured under the test conditions. Cesium adsorption after 1 day was found to be represented by the mass-action equation. The distribution coefficients for cesium adsorption were so large that in all but a few cases very little of this nuclide would remain long in solution in the natural waters of the area. Strontium adsorption was found to be a function of the calcium-plus-magnesium concentration and independent of the sodium concentration. In most samples strontium equilibrium was reached in less than 1 day. Iodine sorption varied with percent organic matter in the samples. If the iodine were in contact with organic matter for several days, a substantial part of it probably would be removed from solution in the natural waters. (Auth)

<80>

Balcar, J., A. Brezinova-Doskarova, and J. Eder, Dependence of Radiostromium Uptake by Pea and Lupin on the Content of Calcium in the Nutrient Solution. 1969. Biologia Plantarum (Praque), 11(1), 34-40 (Czechoslovakia Academy of Sciences, Institute of Experimental Botany, Department of Radiobiology, Prague, Czechoslovakia)

In lupin and pea it was shown that the uptake of strontium 89 from Knop's nutrient solution is significantly increased from a solution with decreased calcium content and is slightly decreased from a solution with higher calcium content. (Auth) (CWF)

<81>

Ballada, J., Analytic Determination of Plutonium in the Environment. 1967. CEA-R-3220; 157 p. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses, France)

Studies on the determination of the plutonium content in fallout from nuclear explosions are described. The importance of the problems due to the plutonium, the physico-chemical properties of the radio-element, and the biological dangers that it presents are discussed. A detailed and critical analysis

<81> CONT.

was made of the radio-toxicological determination of plutonium as previously reported in the literature. Techniques for the determination of plutonium in air, rain-water, soils, and plant ash are presented. After a detailed description of the measurement equipment and the operational techniques which have been developed, a justification of these techniques is given with particular reference to their sensitivity and specificity. The results are then discussed in the case of each element in which plutonium was determined. The importance of the occurrence of fall-out plutonium on problems relating to public health is considered. From a consideration of 200 analyses carried out, it was concluded that the contribution of plutonium to the exposure of populations is still very small compared to that of natural radiation and that due to such fission products such as strontium 90. (63 references). (Auth)

<82>

Bange, G.G.J., and R. Overstreet, Some Observations on Absorption of Cesium by Excised Barley Roots. 1960. Plant Physiology, 35, 605-608 (University of California, Department of Soils and Plant Nutrition, Berkeley, CA)

Steady state Cs absorption was studied in relation to the external Cs concentration and under conditions of low temperature and anoxibiosis. The results are tentatively explained on the basis of a two-fold absorption mechanism. The first mechanism is very effective, reaching a saturation level at a concentration as low as 0.1 mequiv/l (half-value approximately 0.008 mequiv/l). Absorption at this concentration was shown to be sensitive to anoxibiosis. The second mechanism becomes relatively important only at concentrations a hundred-fold higher and is insensitive to anoxibiosis. The possibility of a passive nature of the second mechanism is discussed. The interference by other mono- and divalent cations with Cs absorption in the concentration range from 0.0 to 0.1 mequiv/l was studied. K, Rb, and to a less extent NH₄ inhibited Cs uptake in a way suggesting competition for the same binding site. Li and Mg had little effect on Cs absorption; Na and Ca only affected the overall absorption capacity for Cs; Na in a negative and Ca in a positive sense. (Auth)

<83>

Baranov, V.I., and N.G. Morozova, General Regularities of Natural Radioisotope Distribution in Soils of the USSR. 1970. CONF-690918-(Vol. 1): Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969. (p. 469-491), 684p. (Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

The chief genetic soil types of different climatic zones of the European part of the USSR were studied and the distribution of natural radioisotopes was established. Six hundred and seventy-five samples of soils and soil-forming rocks were analyzed. The content of natural radioelements (in air-dry material) of the investigated soils varied within wide ranges: for Ra from $n \cdot 10^{-13}$ to $n \cdot 10^{-10}$ percent, for Th from $n \cdot 10^{-6}$ to $n \cdot 10^{-3}$ percent, and for K from $n \cdot 10^{-2}$ to n percent. From the obtained data, an attempt was made to draw up radioecological maps in order to study the migration, accumulation, and diffusion of natural radioelements in soils. (Auth)

<84>

Baranov, V.I., and N.G. Morozova, Behavior of Natural Radionuclides in Soils. 1973. Part of Klechkovskii, V.M. (Ed.), Radioecology, John Wiley and Sons, Inc., New York, New York, (p. 3-29), 381 p. (Not given)

Natural radioactivity of soils is reviewed with emphasis on the geochemical aspects of the radioactivity. Tables are presented to show concentration of naturally radioactive U, Ra, Th, and K in soils of various countries and in various types of soils in the USSR. The concentration and distribution of natural radionuclides in major soils of some soil-climatic zones of the USSR are discussed. Radioecological soil maps are considered along with their use in establishment of the general behavior of radionuclide in the planetary soil cover and determination of the role played by the soil-forming process in the geochemistry of natural radionuclides. (76 references) (NSA)

<85>

Baranov, V.I., N.G. Morozova, K.G. Kunasheva, G.I. Griqor'ev, and V.I. Vernadskii, Geochemistry of Some Natural Radioactive Elements in Soils. 1963, August. Soviet Soil Science, 8, 733-740 (Vernadskiy Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

Studies were made of the average content of natural radioisotopes in soil groups of various climatic zones in the USSR and their distribution by genetic horizons. Soil samples were analyzed for radium and thorium by ordinary radiochemical methods. Data are presented in tables. Preliminary investigations showed that there was no significant deviation in the soil samples from the radioactive equilibrium between uranium and radium. The thorium content of different soils varied 400-fold and the radium content 100-fold whereas the content in the underlying rock was within one order of magnitude. Organic matter was found to play an important role in the migration of radioelements. Soils rich in organic residues had the lowest Th:Ra ratio. (NSA)

<86>

Baranov, V.I., P.I. Pavlotskaya, G.A. Fedocev, E.B. Tyuryukanova, L.M. Rodionova, E.V. Babicheva, L.N. Zatssepina, and T.A. Vostokova, Distribution of Strontium 90 in the Surface Level of Soils in the Soviet Union in 1959-1960. 1965. At. Energi. (USSR), 18, 246-250

Data are presented on the distribution of Sr 90 throughout the territories of the Soviet Union in 1959-1960. The distribution is observed to be of a latitudinal nature with maximum values within the limits 50-30 degrees north. On the average, the Sr 90 content in the surface level of soil coverage with a thickness of up to 5 and 15 cm amounted to 14.1 and 17.8 uCi/km². The absence of any increase in content of this isotope in 1960 as compared with 1959 indicates that during the period investigated the quantity of Sr 90 deposited from the atmosphere onto the earth's surface corresponded to the quantity which, because of various processes, was removed from the upper layer with a thickness up to five cm. (Auth)

<87>

Baranov, V.I., and V.D. Vilenskii, The Content of Lead 210 in the Atmosphere and in Atmospheric

<87> CONT.

Precipitations. 1965, May. At. Enerq. (USSR), 18, 503-506

Data are presented on the Pb 210 fallout in the Moscow region in 1961-1963. The mean Pb 210 concentration in the fallout was not related to the amount of precipitation and increased sharply only during drought periods. The intensity of Pb 210 fallout was practically static during spring, summer, and autumn and reduced by a factor of 2 to 2.5 during winter. The mean concentration of Pb 210 does not depend on the season. The mean yearly Pb 210 fallout intensity is approximately 2.8 nCi/m³. The concentrations of Pb 210 in the air over the Pacific and Indian Oceans fluctuated from (0.1 to 16.0) x 10⁻³ nCi/m³. Variations in Pb 210 concentration in air over the ground and the ocean could be used for studying meteorological factors inducing the transfer of radioisotopes in the troposphere and their fallout on the earth's surface. (tr-Auth)

<88>

Baranova, D.D., Comparative Investigation of Sorption and Desorption of Various Radionuclides by Marine Shallow-Water Soils. 1967. AEC-tr-6940

The role of certain Black Sea soils in the distribution of Ce 144, Cs 137, Ru 106, Sr 90, Y 91, and Zr 95 was investigated. Sorption factors were determined for samples of soil collected at various locations. The samples included shell rock, sand, and aleuritic and phaseolitic sediments. The highest content of radioisotopes was found in sediments containing shells of mollusks. (NSA)

<89>

Barber, D.A., Influence of Soil Organic Matter on the Entry of Cesium 137 into Plants. 1964. Nature, 204, 1326-1327 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Cesium 137 uptake data by perennial ryegrass suggest that in soils of limited clay content the dominant soil property controlling the uptake of radiocesium is soil organic matter. (CWF)

<90>

Barber, D.A., and W.A. Mitchell, The Entry of Cesium 137 and Strontium 90 into the Herbage of Permanent Pasture. 1964. ARCL-12; (p. 59-61) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Growing turfs from different types of pasture were contaminated with Cs 137 and Sr 90 and the levels of both nuclides in regenerating herbage were determined over a period of two years. Results indicated that within the first year after contamination plant-base absorption is important in the uptake of both nuclides whereas in the second year the levels of Cs 137 in the regenerated herbage could be largely attributed to the entry of the nuclide from the soil. Uptake increased with increasing levels of soil organic matter. (ST)

<91>

Barber, S.A., S.M. Elgawhary, and G.L. Malzer, Characterization of Nutrient Supply Mechanisms to Plant Roots Using Double Labeling and the Ratio of Calcium/Strontium Absorbed. 1971. CONF-711213; IAEA/SM-151/33; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships

Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971, 10 p. (Purdue University, Agronomy Department, Lafayette, IN)

Evaluation of mass flow and diffusion mechanisms were carried out by growing tomato plants in sand-resin mixtures. In a differential precipitation experiment with calcium and strontium sulfates, there appeared to be a small quantity of co-precipitation of strontium with calcium sulfate but little co-precipitation of calcium on to the strontium sulfate. (CWF)

<92>

Barber, S.A., and G.L. Malzer, Movement of Strontium through the Soil to the Plant Root Membrane, Technical Progress Report, September 1, 1972 - August 31, 1973. COO-1495-22; 32 p. (Purdue University, Lafayette, IN)

This project investigates the mechanisms of supply of Ca and Sr to the plant and the absorption of these ions into the root. The source of Ca and Sr absorbed was determined on the basis of the Ca/Sr ratio of uptake since different phases of the root media varied in Ca/Sr ratio and the plant root did not discriminate between Ca and Sr. Precipitation of CaSO₄ at the root surface was also shown both by autoradiographic procedures and by examination of roots with a petrographic microscope. Calcium sulfate and SrSO₄ precipitated differentially with little co-precipitation. When tomato plants were grown in solutions with equal concentrations of soluble chelated Ca and Ionic Ca, the uptake rate of chelated Ca was one-fourth the uptake rate of ionic Ca. Adding a soluble chelate to a solution of Ca and Sr depressed Ca uptake relative to Sr uptake with the rates being related to the difference in the stability constants of the Ca and Sr chelates. In addition, plant species differed in their rates of uptake of chelated vs ionic Ca and Sr. (Auth)

<93>

Barnowski, R., J. Bors, and S. Przestalski, Contamination of Soils with Strontium 90 at the Experimental Institute of Laskowice. 1965. Zesz. Nauk. Wyzsz. Szk. Roln. Wroclaw, 19, 109-116

Strontium 90 contamination of tested soils was found to be 20 to 160 x 10⁻¹² Ci/kg of soil. Contamination of uncultivated soils was two to three times that of cultivated soils. (NSA)

<94>

Barrows, H.I., M.S. Neff, and M. Gammon, Jr., Effect of Soil Type on Mobility of Zinc in the Soil and on the Availability from Zinc Sulfate to Tunq. 1960. Soil Science Society of America Proceedings, 24, 367-372 (U.S. Department of Agriculture, Agricultural Research Service, Crops Research Division, Bozalus, LA; U.S. Department of Agriculture, Agricultural Research Service, Crops Research Division, Cairo, GA; Florida Agricultural Experiment Station, Gainesville, FL)

A field experiment was designed for study of the effects of soil type on movement of zinc in the soil and of soil type and levels and placements of zinc sulfate on growth of one year tunq trees. (Auth) (CWF)

<95>

Bartlett, B.O., and R.S. Russell, Prediction of Future Levels of Long-Lived Fission Products in

<95> CONT.

Milk. 1966. Nature, 209, 1062-1065
(Agricultural Research Council Radiobiological
Laboratory, Wantage, Berkshire, England)

Models were constructed for the prediction of
cesium 137 and strontium 90 concentrations in
milk. Soil factors are included in the
models. (CWF)

<96>

Basu, A.N., and S.K. Mukherjee, Interaction
Between Montmorillonite Clay and Trace Element
Cations II. Exchange Behavior of Cobalt, Nickel
and Chromium Ions in Clays. 1965. J. Indian
Soc. Soil Sci., 13, 251-256 (University Colleges
of Science & Technology, Calcutta, India)

The exchange isotherms of Ni-, Co-, and
Cr-clays were obtained against Na, K, NH₄, H,
Mg and Al ions. In general, the following
order of release is shown: Co=Ni greater than
Cr. The sequence of adsorption is the reverse
of it. These sequences are more or less in
agreement with the lyotrope series. The
exchange behavior of H ion is anomalous, as
has often been observed in the case of similar
colloidal reactions. The exchange behaviors
of NH₄ and K, and Co and Ni ions, each pair
having nearly identical radii, are nearly the
same. (Auth)

<97>

Bauman, A., Determination of Cesium 137 in Soil.
1968. CONF-660920-1; Part of Snyder, W.S.,
et.al. (Eds.), Proceedings of the 1st IAEA
Congress on Radiation Protection held in Rome
Italy. Pergamon Press Inc., New York, New York,
Part 1, (p. 335-338) (Institute for Medical
Research, Zagreb, Yugoslavia)

The method is based on the final precipitation
of Cs 137 as cesium triphenylcyanoborate.
Sodium triphenylcyanoborate has not been used
before as a reagent for determination of
radioactive cesium, at least not in the
samples of biosphere. Conditions of optimal
leaching of Cs 137 from various types of soil
were found. A 256-channel analyzer was used
for sample counting. Conditions of optimal
precipitation of cesium were determined.
(Auth)

<98>

Bauman, A., and V. Popovic, Determination of
Strontium 90 in Soil. 1964. Arh. Hig. Rada
Toksikol., 15, 3-8 (Institute for Medical
Research and Occupational Medicine, Zagreb,
Yugoslavia)

A description is given of a method for site
selecting and for determining strontium 90 in
soil. In 1962 there were 4.35 mCi of Strontium
90 per square kilometer around Zagreb; in 1963
there were 7.43. (NSA)

<99>

Bazhenov, Y.M., Study of Conditions for Burial of
Radioactive Cement in Soils. 1967. JPRS-42565;
CONF-670512; STI/PUB-156; Part of Proceedings of
the Joint IAEA/ENEA Symposium on the Disposal of
Radioactive Waste into the Ground held in Vienna,
Austria, May 29-June 2, 1967, (p. 23-35)

Conditions affecting the burial of
concrete-solidified radioactive wastes were
investigated. The effects of the soil and
ground water on the release of radioisotopes
from the waste were studied. It was concluded
that due to leaching of radioisotopes, only
concrete blocks with an activity of less than

10(E-6) Ci/l with respect to Cs 137 and Sr 90
can be stored safely without hermetic sealing
and waterproofing, that concrete blocks with
activities of 10(E-5) Ci/l or less can be
stored safely under a loam covering, and that
the quantity of gaseous radiolysis products
liberated during the storage of concrete
solidified waste depends on the specific
activity of the concrete block, the storage
time, air space volume in the vessel, and the
volume and geometry of the blocks. (NSA)

<100>

Beasley, T.M., Lead 210 Production by Nuclear
Devices: 1946-1956. 1969, November. Nature,
224, 573 (University of Washington, Seattle, WA)

The possible production of Pb 210 during
weapons testing by the reaction Pb 208(2n,
gamma)Pb 210 is discussed. Unusually high
ratios of Pb 210 in tropospheric air in 1962
and 1963 and in lichens and deer antlers in
1958 to 59 and 1962 to 63 were reported; on
the other hand, no corresponding increase in
air or glaciers and the stratosphere in 1966
was reported by other workers. Resolution of
this difference in findings was considered
important since it was postulated that nuclear
devices used in excavating a canal in Central
America might produce Pb 210 in amounts
comparable with Sr 90-Y 90. If Pb 210 is
produced in significant amounts during nuclear
explosions it should be present at former test
sites at Bikini and Eniwetok Atolls, and the
presence of Bi 207 at these sites suggests
that stable lead was present in shielding or
other structures adjacent to the nuclear
devices. Determinations of the Pb 210 content
of soil and sediment samples from areas of
high radioactivity in the Pacific Proving
Ground and, for comparison, from areas of the
Pacific with negligible fallout are reported;
three of the samples contained Bi 207. The
results show concentrations of Pb 210 that do
not exceed those expected to occur naturally,
and if Pb 210 had been produced in significant
amounts during the testing program the
concentrations in crater sediments would have
been much greater than found. (Auth)

<101>

Beasley, T.M., Lead 210 in Selected Marine
Organisms. 1969. Ph.D. Thesis; 92 p. (Oregon
State University, Corvallis, OR)

The concentrations of Pb 210 have been
determined in a variety of marine organisms.
The specimens analyzed were taken during
different times of the year and consequently
during different hydrographic regimes which
afforded the opportunity to compare Pb 210
concentrations in organisms living in upwelled
water further from shore. Less extensive
measurements of Po 210 in the same species
permitted an estimate of the radiation dose
rate to which these organisms may be subject
from this internally deposited isotope, in
addition to that which results from cosmic
rays and the K 40 which is ubiquitous in ocean
waters. The concentrations of Pb 210 in
marine organisms from trophic level II and III
were generally well correlated with inshore
and offshore stations. This can be explained
if one considers the input of this isotope
from rainfall and the offshore transport of
isotope enriched water due to upwelling.
During the conditions of high coastal rainfall
inshore organisms residing in the surface
layers of the ocean (upper 100 meters)
displayed higher Pb 210 concentrations than
did the same species offshore (greater than 45
nautical miles). Under conditions of low
rainfall and offshore transport of surface

<101> CONT.

water, the organisms at more than 45 nautical miles offshore generally showed higher Pb 210 concentrations than did those inshore. Lead 210 concentrations in lanternfish, which have been shown to reside at different depths in the water column, displayed decreasing concentrations of Pb 210 as their depth of residence increased. Similar results reported for stable lead measured in waters off the California coast would suggest that perhaps inorganic processes regulate the amount of lead in surface waters rather than biological ones. Ratios of Po 210/Pb 210 in oceanic organisms exceeded 1 in all cases, showing preferential uptake of Po 210 even though the ratio of these isotopes in rainwater, the major input source, has been measured at approximately 0.1. Although the interpretation of this result requires clarification, it is postulated that changes in chemical form of the isotopes as they enter the marine environment, coupled with differences in the effective half life exhibited by each isotope in the organisms, combine to produce higher Po 210 levels than those observed for Pb 210. The radiation dose rate for fishes residing near the surface is shown to increase some 6 fold as a result of internal Po 210 concentrations, yet this figure would be expected to show variation depending upon Po 210 input to surface waters, and turnover times in the organisms. Benthonic polychaetes, which receive high dose rates from Ra 226 incorporated in marine sediments showed an increase in dose rate of some 2 fold, giving possible total dose rates approaching 1.4 Rad/year. (Auth)

<102>

Beckett, P.H.T., Studies on Soil Potassium. I. Confirmation of the Ratio Law: Measurement of Potassium Potential. 1964. J. Soil Sci., 15, 3-7 (Oxford University, Soil Science Laboratory, Oxford, England)

The activity ratio a_K/a_{Ca+Mg} had the same value for all solutions in equilibrium with a chosen soil, regardless of their concentration (up to 0.06 M), or of the proportion of Ca to Mg. The activity ratio may be expected to provide a satisfactory measure of the ruling chemical potential of labile K in a soil, provided it is not used to compare soils of widely different Ca (and Mg) status, or a few soils of which the activity ratio is not independent of the concentration of the soil solution. (Auth)

<103>

Belot, Y., and C. Gailledreau, Kinetics of Strontium 90 Retention by a Calcite-Phosphate Reaction Extrapolation Assay. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Commissariat a l'Energie Atomique, Service de Controle des Radiations et de Genie Radioactif, France)

The influence of different parameters on strontium 90 retention was studied using synthetic solutions. The parameters were length of columns, flowed volume, flow rate, phosphate ion concentration and sodium concentration. From a simple hypothesis an extrapolation formula is given and compared with the experimental results. It is planned to use calcite columns to treat waste waters. (Auth)

<104>

Belot, Y., C. Gailledreau, and R. Rzekieckie, Retention Du Strontium 90, Du Calcium 45 et Du Baryum 140 Par un Oxyde D'Aluminium De Grande Surface. 1966. Health Physics, 12, 811-823 (Commissariat a l'Energie Atomique, Paris, France)

A bauxite of large specific area was tested for cationic exchange properties. The cationic sorption increased with pH of the solution: for calcium or sodium it reached a value of 43 μ moles/100 g at pH 12. This bauxite was then wetted by binary solutions, where the sodium ion was the macrocomponent and the alkaline-earth ion the microcomponent. By counting strontium 90, calcium 45 or barium 140 the distribution of the microcomponent was checked at different times. An equilibrium was reached, sometimes very slowly. From equilibrium data, "adsorption isotherms" were plotted and selectivity coefficients computed. The alkaline-earth cations behave like monovalent species, but their apparent binding energy is unusually high and increases with their dilution on the surface of the activated oxide. Several assumptions are made to explain this behavior. (Auth)

<105>

Belot, Y., and N. Pignou, Comportement Du Nitrosyl-Ruthenium Dans Une Eau De Surface Simulee En Presence De Chelatants Naturels. 1968. Health Physics, 15, 443-450 (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Department of Sanitary Protection, Radioecology Section, Fontenay-aux-Roses, France)

An experiment was developed on the behavior of nitrosyl-ruthenium in the presence of potentially complexing organic compounds. In simulated natural water buffered at pH 8, carboxylic acids were dissolved with carrier-free ruthenium. Under these conditions soluble organic complexes were produced from colloidal hydroxy ruthenium. That complex formation can be evidenced by measuring the relative amount of dissolved species with ultrafiltration or gel chromatography. The data indicated that the mercapto-carboxylic acids are the best complexing agents, then come, without any noticeable difference, amino-acids, hydroxy-carboxylic acids and uronic acids. The same soluble ruthenium complex might be produced in some natural conditions. (Auth)

<106>

Benck, R.F., C. Crisco, A.W. Runquist, and E.P. Holdsworth, Characterization of Fallout Particles from Electron Microprobe X-Ray Analyses. 1973. Health Physics, 25, 188-191 (U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, MD; Northwestern University, Department of Chemistry, Evanston, IL; Arizona State University, Department of Geology, Tempe, AR)

Electron Microprobe X-ray analysis of radioactive fallout produced by detonations at Nevada and Bikini are presented. Particles formed in the Pacific were rich in Ca and Mg while particles formed over Nevada were aluminum silicates containing Fe, Ca and K. The radioactivity was largely confined to small, clear, fused-glassy spheres which proved to be fused silica containing varying amounts of homogeneously distributed Fe, Al and K. (CWF)

<107>

Benecke, P., Investigations into the Behavior of Precipitation Water in Soils by Means of Iodine

<107> CONT.

131. 1967. CONF-670641; STI/PUB-158; Part of Proceedings of a Symposium on the Use of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies held in Istanbul, Turkey, June 12-16, 1967, (p. 227-238) (University of Göttingen, Göttingen, German Federal Republic)

In a drained silty soil the groundwater was filled to surface level using artificial precipitation. After this a KI 131-solution was added at a defined spot between two drains. Using a scintillometer the spread of the radioisotope was recorded at varying times. The results were plotted as isorates (lines connecting points of equal activity at the same time in the soil profile). The activity maximum remained at the spot of initial activation during the investigation period (two weeks). Within a few minutes after application, however, small activities of I 131 were found one meter away from the point of application, in both a vertical as well as a lateral direction towards the nearest drain. The movement was mainly directly downwards and closely followed a half-logarithmic time:distance relationship. From this, the minima of the observed water-flow velocity were calculated. The influence of the physical soil properties on the spreading was represented by a proportionality constant. An interpretation of this constant is difficult because of the complexity of factors involved. In addition to these quantitative results interesting qualitative conclusions can also be drawn from studying the pattern of the isorate lines: the streamlines towards drainage penetrated the subsoil to a depth of more than 2 m; a former drain ditch showed a higher permeability than the undisturbed soil. This meant that mechanical cultivation remains effective even after decades in silty soils; and vertical water flow was hindered at the borders of layers of different texture, even where there was a higher permeability in the underlying layer. (Auth)

<108>

Benes, J., Contamination of Soils and Plants by Artificial Radioactivity. 1968. Jad. Enerq., 14, 182-188 (Laboratory for Radiometric Dosimetry, Prague, Czechoslovakia)

Sorption of artificial radioactive substances by soil, sorption and desorption of radioactive waste, and factors influencing these processes are discussed. The uptake of radioactive elements from soil by plants, especially the uptake of radionuclides by the roots of plants in the course of food supply, is evaluated. (tr-Auth)

<109>

Benes, J., Radiochemical Methods of Strontium 90 Dosimetric Control in Cereals. 1970, September. Jad. Enerq., 16, 296-299 (Institute of Nuclear Research, Prague, Czechoslovakia)

Six chemical separation methods for the determination of Sr 90 in cereals and other plant materials are evaluated. The yields and reproducibility of determinations and the effects of silicates on the Sr 90 determination are also treated. (Auth)

<110>

Benes, J., Natural Radioactivity of Soil and Plants. 1968. Jad. Enerq., 14, 100-104 (Institute of Nuclear Research, Jädeä, Czechoslovakia)

Dosimetric criteria and methods for isolating

radioisotopes are discussed. Measurements were made of gamma radiation from K 40 in order to determine the amount of potassium in soils, plants, and commercial fertilizers. (NSA)

<111>

Benes, J., and Z. Dlouhy, Sorption of Cesium 137 and Strontium 90 on Czechoslovak Soils in the Presence of Competitive Ions. 1972. Jad. Enerq., 18, 312-315 (Academy of Science, Laboratory of Radiological Dosimetry, Prague, Czechoslovakia)

Among the Czechoslovak soils the highest degree of Cs 137 and Sr 90 sorption was found with chernozem, the lowest degree with podzolic soil. Sorption was conspicuously affected by an excess of competitive ions. Agents were found to transfer both radionuclides into solution from any soils occurring in the CSSR. (Auth)

<112>

Benes, J., and Z. Dlouhy, Retention of Radioactive Substances in Soils: Properties of Czechoslovak Soils. 1972. Jad. Enerq., 18, 229-232 (Academy of Science, Prague, Czechoslovakia)

The rates of sorption of Sr 90 and Cs 137 by samples of most of the major soil types in Czechoslovakia were determined. (Soils and Fertilizers)

<113>

Benes, J., and A. Mastalka, Determination of Radioactive Iodine in Plants. 1968. Jad. Enerq., 14, 390-393 (Institute of Nuclear Research, Prague, Czechoslovakia)

Descriptions are given of a radiochemical method for determining radioactive iodine in plants by capturing elementary iodine from the gaseous media into the carrier column with tetrachloromethane. Factors influencing the yield, separation of iodine from solutions, and capture into tetrachloromethane were evaluated. (NSA)

<114>

Benes, J., and M. Fanyr, Potassium and Cesium 137 Desorption from Soils. 1969. Jad. Enerq., 15, 299-302 (Institute of Nuclear Research, Prague, Czechoslovakia)

The 11 methods recommended for potassium extract preparation from soils were compared and the results were used in Cs 137 desorption. The desorption effects of hydrochloric acid and ammonium acetate for Cs 137 were compared in relation to the ratio of extracting agent to soil. The conditions for Cs 137 and K determinations in soils were discussed. (Auth)

<115>

Bensen, D.W., Review of Soil Chemistry Research at Hanford. 1960, August 10. HW-67201; 42 p. (Hanford Atomic Products Operation, Richland, WA)

The soil chemistry work at Hanford, Washington is reviewed. Soil pH was considered to be the dominant factor for adsorption of radionuclides especially strontium. The rate at which movement of radionuclides occurred through Hanford soil was: Ru greater than Cs greater than Sr greater than rare earths greater than Pu. (CWF)

<116>

Berdnikov, A.I., and V.F. Oreshko, On the Possibility of Using Soils for the Purification of Low Radioactivity Sewer Waters. I. Adsorption of Cobalt 60 by the Soil of Peat Bogs. 1964. Izv. Vyssh. Ucheb. Zaved., Khim. Tekhnol., 7, 594-597 (Medical Institute, Moscow, USSR)

The adsorption by peat soils of Co 60 from aqueous solutions was investigated as a function of the nature, degree of decomposition, granulometric composition, concentration of the radioisotope, and pH of the medium. It was found that peat soils readily adsorb Co 60 from solution. The maximum rate of sorption was possessed by hypanum and wood-floodplain samples with low (10 percent) and medium (50 percent) degrees of decomposition. The radioactivity level of the solution exerted practically no influence on the sorption process. The maximum adsorption fell within the range of pH values from 5.0 to 8.0. The possibility of complexing Co 60 with the primary and secondary amino groups of peat, as well as with the sulfo groups in hydrochloric acid medium and with hydroxycarboxylic acids in alkaline medium is suggested as an explanation of the observed pattern of sorption. Peat soils are recommended as cheap natural absorbents in the purification of waters with low radioactivity. (Auth)

<117>

Bergamini, P.G., G. Palmas, F. Piantelli, and M. Rizzato, Absorption and Distribution of Cesium 137 by TRIFOLIUM PRATENSE. 1970, October. Health Physics, 19, 521-528 (University of Siena, Siena, Italy)

Growths of TRIFOLIUM PRATENSE were contaminated by means of three solutions of Cs 137-labeled CsSO₄ having different concentrations. Each one of the three solutions was used for contamination at three distinct stages of the plant's development, in two different ways: contamination of the soil only and contamination by means of overhead irrigation. The specific radioactivity of the plants was followed from their contamination up to about 80 days after the first flowering. The concentration factor was calculated for each sample. Autoradiographs were also produced. (Auth)

<118>

Bhatnagar, A.S., Radon Measurement in Soil in the Exploration for Uranium in India. 1969. STI/PUB-279; CONF-691229; Part of Proceedings of a Panel on Nuclear Techniques and Mineral Resources in Developing Countries held in Krakow, Poland, December 8-12, 1969, (p. 157-162), 194 p. (Department of Atomic Energy, New Delhi, India)

Radon distribution in soil is influenced by many factors and present knowledge on these factors is incomplete. Daily variation in the results of radon measurement made at the same station has been noted. This indicates that the measurement is subject to unknown influences and any interpretation based on a single observation can be very misleading. The radon content of the soil is derived not only from the parent material diffused in the soil, but also from the migration of radon from another source containing a higher concentration of the parent. In interpreting a radon anomaly it is necessary to distinguish between the contributions made by these two types of sources. Because of the influence of the unknown factors, the problems of interpretation become very entangled. Since the migration of radon from a distant source

with a large concentration of its parent is highly subject to meteorological factors, it is suggested that the unaccounted fluctuations in observed radon values may be themselves taken as an indication of the presence of a distant large source, such as a uranium deposit in the area. (Auth)

<119>

Bhujbal, B.M., T.J. D'Souza, and K.B. Mistry, Discrimination between Radium and Calcium in the Soil-Plant System. 1972. CONF-701227; Part of Proceedings of a Symposium on Radiation and Radioisotopes in Soil Studies and Plant Nutrition held in Bangalore, India, December 21, 1970. Department of Atomic Energy, Bombay, India, (p. 155-165) (Bhabha Atomic Research Centre, Bombay, India)

Three types of soil, alkaline black clay, acidic red loam, and laterite, were used in the experiments. The distribution of radium and calcium between the soil solution and the soil was examined by comparing the extent to which Ra 226 and Ca 45 added to equilibrium soil solution were removed by the soil. Maize (ZEA MAYS) and bean (PHASEOLUS VULGARIS) plants were grown in the three soils labeled with Ra 226 and Ca 45. After three weeks the shoots were harvested and assayed for Ra 226 and Ca 45. Data indicated that the absorption of radium by plants grown in the three soils was considerably lower than that of calcium. The plant soil factor (ratio of Ra 226/Ca 45 in shoots to Ra 226/Ca 45 added to soil) showed strong discrimination against Ra 226 in the transfer from soil to plant. (NSA)

<120>

Bhujbal, B.M., and K.B. Mistry, Studies on the Leaching of Radiostrontium Through Typical Soils. 1971. CONF-701227; Part of Proceedings of a Symposium on Radiation and Radioisotopes in Soil Studies and Plant Nutrition held in Bangalore, India, December 21, 1970. Department of Atomic Energy, Bombay, India, (p. 49-62) (Bhabha Atomic Research Centre, Bombay, India)

Experiments were performed to evaluate the effects of leaching with deionized water, 0.005N CaCl₂, and 0.005N NaCl on the quantity of Sr 89 removed from a contaminated layer of soil and on the vertical movement of Sr 89 in soil columns. The results indicated that some of the treatments employed can result in the leaching of significant quantities of radiostrontium out of the contaminated soil layer. The EDTA and moderately high calcium irrigation water treatments also lead to considerable vertical movement of the nuclide in the soil profiles. However, it is noteworthy that under conditions of the present study, which involved leaching of large volumes of solutions over prolonged periods, the maximum depth to which radiostrontium was moved was 15 cm. It is clear, therefore, that while dealing with an actual situation which requires decontamination of the surface soil layer the leaching treatments would have to be combined with other measures such as plowing under of the top soil. Further, in order to minimize the radioactive contamination of the food chain these measures should necessarily be combined with application of lime and organic matter to soil in the root zone which leads to reduced uptake of radiostrontium by crop plants. (NSA)

<121>

Birkle, D.E., J. Letey, N.T. Coleman, and W.F. Richardson, Uptake by Plants of Cesium 137,

<121> CONT.

Cerium 144, and Yttrium 91 as Influenced by Rhizosphere Oxygen Treatments. 1965. Soil Science, 99, 93-97 (University of California, Citrus Research Center and Agricultural Experiment Station, Riverside, CA)

The uptake of cesium, cerium, and yttrium in tomatoes, beans and barley was studied in nutrient solutions and soils under various oxygen concentrations in the root environment. (CWF)

<122>

Bisbjerg, G., and G. Gissel-Nielsen, The Uptake of Applied Selenium by Agricultural Plants. I. The Influence of Soil Type and Plant Species. 1969. Plant and Soil, 31, 287-298 (Danish Atomic Energy Commission, Agricultural Research Department, Risoe, Roskilde, Denmark)

A comparison of plants grown on 6 soils showed that their ability to take up Se 75 varied by one order of magnitude when potassium selenate was the source of Se 75 and by a factor of 5 when selenite was the source. The uptake of selenate was, on an average, 8 times that of selenite. Five of the 6 soils used were representative of the greater part of the Danish agricultural area while one of them was a special case. The effect of selenium application was found to be much the same in the common soils although the concentration in the plants was sometimes twice as high on sandy as on loamy soils. For most areas concentration of Se 75 in the plant was roughly inversely related to the clay content of the soil. The Se 75 concentration in the plants varied with their stage of development. In barley the concentration was lower in straw and grain than in the green plant, in mustard it depended on the oxidation state of the Se. Grain and seed, in general, contained more Se than the straw. Of 10 plant species the cereals had the smallest uptake of Se 75. The uptake by red clover seemed to be favored by an excess of available Se while at moderate levels rye grass was a better accumulator than the clover. When the selenate addition was increased by a factor of 25, the plant level of Se 75 increased 70 fold; for selenite the factor was 50. The application of 0.1 ppm selenite-Se or somewhat less selenate leads to a useful Se level in plants in pot experiments. (Auth) (NSA)

<123>

Bittel, R., Discussion of Factors Promoting the Radioactive Contamination of Cultivated Crops. 1965. Ann. Agron., Hors-Ser., 16, 265-286 (Commissariat a l'Energie Atomique, Centre D'Etudes Nucleaires, Fontenay-aux-Roses, France)

Plants take-up from the biosphere radioactive elements originating from radioactive fall-out and irrigation water. The mechanisms of absorption are the same as those operating for stable elements in mineral nutrition. (Auth) (CWF)

<124>

Bittel, R., J.M. Blum, J.J. Jaumier, and J.L. Verot, Physico-Chemical Processes of Transfer of Radioruthenium in Continental Environment. 1969. CONF-690918-3; CEA-CONF-1430; Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (16 p.) (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France; Societe Unione Kuhlmann, Sevres, Paris, France)

The physical chemistry of ruthenium is complicated because of the numerous valence states corresponding to salt combinations and complexes. Two radioisotopes of Ru with average life, Ru 106 and Ru 103, are present in numerous liquid radioactive effluents. This is evidently the result of the difficulties of decontamination and is explained as a function of the physical chemistry of the element. Therefore, these Ru radioisotopes can contribute to the contamination of the continental environment. In liquid effluents and their emanatories, the radioisotopes have various physicochemical states and it seems probable that the varied behavior of Ru in the dispersion medium is explained in part by differences between the physicochemical states of the element. The principal difficulties which the experimenter encounters are due to the varied behavior of solutions of radioruthenium used up to the present, to the multiplicity of the equilibria existing in dilute solution between the different forms of Ru, and to the lack of fidelity of the data from the analysis. It is proposed to alleviate the first difficulty by operating with well defined compounds and the third by obtaining data complementing each other which will probably lead to interpretable data concerning the second. In the first phase of experimental work, well-defined compounds of radioruthenium were prepared. The conditions of use of these compounds are discussed as well as data to be attained from experiments using these compounds for the study of the transfer of radioruthenium into the continental environment. (tr-Auth)

<125>

Bittel, R., M. Merlini, C. Myttenaere, and P. Bourdeau, Transport of Radiocobalt in a Simple Artificial Ecosystem Irrigated by Submersion. 1970. CONF-690918-(Vol. 1); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 413-438), 684 p. (Commissariat a l'Energie Atomique, Centre D'Etude Nucleaires, Fontenay-aux-Roses, France)

The behavior of radiocobalt in ecosystems irrigated by submersion was studied. For this purpose, artificial rice-plantations under glass are used and conditions necessary for irrigation are created. Fresh water bivalves, UNIO MANCUS ELONGATULUS, are employed. A double labeling (Co 60 in irrigation water and Co 58 in soil) has allowed the behavior of Co in soil, water, and organisms to be studied as a function of the origin and of the physicochemical nature of Co. The important results are as follows: preponderant absorption of Co from water by microorganisms; preponderant absorption of Co introduced in the ionic state; and faster migration of complexed Co. The above results are discussed in terms of radioprotection of food and environment. (Auth)

<126>

Bittel, R., M. Merlini, C. Myttenaere, and O. Ravera, Study of the Parameters of Radiocobalt Transfer in Continental Aquatic and Irrigated Ecosystems. 1971, March. EUR-4628; CEA-R-4175 (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France)

Studies on the behavior of cobalt in aquatic and irrigated systems are of great interest because of the role of cobalt as an essential element for some animals and plants, its presence in various industrial wastes, and the presence of some of its isotopes with a long

<126> CONT.

half-life in nuclear wastes. Cobalt chemistry is highly complex and its behavior can be modified as a function of its physico-chemical state in wastes and in its dispersal in the environment. As a result, it is difficult to foresee and assess the hazards from a release of cobalt into chemically different environments. The studies reported had a practical purpose, that of assessing the effects of water contaminated by Co 58 and Co 60, on the food chain of gold fish. From the results obtained on the study of Co 58 and Co 60 in a freshwater environment, the radionuclides of cobalt do not appear to be critical radioisotopes except in the case of their presence in water used for the irrigation of food crops. (Auth)

<127>

Black, S.C., and E.W. Bretthauer, Polonium 210 in Tobacco. 1968, March. Radiological Health Data and Reports, 9, 145-154 (Southwestern Radiological Health Laboratory, Las Vegas, NV)

Variations of Po 210 content in tobacco, the amount of Po 210 in various fractions of smoked cigarettes and changes in Po 210 content of mainstream smoke caused by variation in the smoking procedure were determined. The average Po 210 content for whole cigarettes was found to be 0.483 pCi/gram and 0.477 pCi/gram for butts. No Po 210 enrichment in the butt of cigarettes during smoking was found. Polonium 210 content and concentration in mainstream smoke increases with puff size. (Auth)

<128>

Bliss, W., and L. Dunn, Measurement of Plutonium in Soil Around the Nevada Test Site. 1971. CONF-710401; Part of Rocky Flats Symposium on Safety in Plutonium Handling Facilities held in Golden, Colorado, April 13-16, 1971, (p. 320-327) (Southwestern Radiological Health Laboratory, Las Vegas, NV)

Experiments conducted at the Atomic Energy Commission's Nevada Test Site between 1951 and 1963, using plutonium in both critical and sub-critical configurations, have resulted in distribution of plutonium beyond the boundaries of the Test Site. The Southwestern Radiological Health Laboratory of the Environmental Protection Agency is conducting a survey to assess the distribution and concentration of plutonium in the off-site environment. Special sampling methods were devised since desert soil is too coarse and dry for auger and cookie cutter sampling techniques. Soil sample analyses are performed by a dissolution, ion exchange, electrodeposition procedure followed by alpha spectroscopy. Plutonium has been detected in four locations around the Nevada Test Site. These locations correspond to fallout areas previously identified for the various test series. Plutonium concentrations in the top 3 cm of soil were 10 to 100 times greater than the concentration in soils from areas not subject to contamination by these series. (Auth)

<129>

Bloksma, A.H., The Diffusion of Sodium and Iodide Ions and of Urea in Clay Pastes. 1957. Journal of Colloid Science, 12, 40-52 (University of Wageningen, Laboratory of Agricultural Chemistry, Wageningen, Netherlands)

By means of layer analysis and the use of radioactive isotopes the author measured the

rates of self-diffusion of sodium and iodide ions in clay-water pastes. In the same pastes the diffusion rates on sodium iodide and of urea were measured. The clays used were montmorillonite and kaolinite having sodium ions as adsorbed ions. (Auth) (CWF)

<130>

Blume, H.P., U. Zimmermann, and K.O. Muennich, Tritium Tagging of Soil Moisture: The Water Balance of Forest Soils. 1967. CONF-670641; STI/PUB-158; Part of Proceedings of a Symposium on the Use of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies held in Istanbul, Turkey, June 12-16, 1967 (p. 315-331) (University of Heidelberg, Heidelberg, German Federal Republic)

A method of tagging soil moisture with tritium in order to measure water movement and groundwater recharge, and the results obtained by this method were reported previously. The amount of tritium to be applied is evaluated. A new technique of labeling was tested. The soil was inoculated with tritiated water with a syringe to a depth of approximately 20 cm. This technique prevents the following effects occurring if the tracer remains for a longer time in the immediate neighborhood of the soil surface such as high evaporation loss of the tracer, asymmetry of the tracer-concentration distribution, and heavy rains overtaking the tracer peak if there are cracks in the upper soil layers. The spatial distribution, both vertically and horizontally, of the tritium thus injected into a sandy soil was measured after artificial sprinkling. The influence of varying water content in the soil on the tracer-concentration distribution and the influence of a clay pan on the water movement were investigated. Also presented are results obtained in a forest soil tracer study at present being conducted over a two-year period. Two individual labelings at the same place, but six months apart, demonstrate the uptake of water by the roots between the two tracer marks. (Auth)

<131>

Bochkarev, V.M., Z.G. Antropova, and E.I. Belova, Migration of Strontium 90 and Cerium 144 in Soils of Different Texture. 1964. Soviet Soil Science, 9, 936-938 (Institute of Biophysics, Moscow, USSR)

Ninety and 85 percent of the applied strontium 90 and cerium 144, respectively, was found two years later in the top five cm of medium and coarse clay loam Podzolized Chernozems. (CWF)

<132>

Bole, J.B., and S.A. Barber, Differentiation of Strontium-Calcium Supply Mechanisms to Roots Growing in Soil, Clay, and Exchange Resin Cultures. 1971. Soil Science Society of America Proceedings, 35, 768-772 (Purdue University, Agricultural Experiment Station, Lafayette, IN)

The ratio of Sr/Ca taken up by soybean roots growing in soil, clay, and exchange resin media was used to evaluate the mechanisms supplying these cations to the root surface. When mass-flow supplied more than uptake the Sr/Ca ratio of uptake was similar to the Sr/Ca ratio in the soil solution. This is the ratio for the mass-flow supply mechanism. When mass-flow supplied a minor proportion of uptake, the Sr/Ca ratio of uptake corresponded to the Sr/Ca ratio of the exchange cations rather than the solution cations. This indicated that the supply by contact of the media with the root and by diffusion was in

<132> CONT.

the ratio of Sr/Ca found on the exchange sites. (Auth)

<133>

Bolt, G.H., M.E. Sumner, and A. Kamphorst, A Study of the Equilibria Between Three Categories of Potassium in an Illitic Soil. 1963. Soil Science Society of America Proceedings, 27, 294-299 (State Agricultural University, Laboratory of Soils and Fertilizers, Wageningen, Netherlands)

The release of K from K-Ca-illites by repeated extraction with 0.5 N solutions of various salts was determined. (Auth) (CWF)

<134>

Bonner, W.P., H.A. Bevis, and J.J. Morgan, Removal of Strontium from Water by Activated Alumina. 1966. Health Physics, 12, 1691-1703 (University of Florida, Gainesville, FL)

Data are presented which show a mathematical model based on the law of mass action to be applicable to the description of strontium removal from solutions of low ionic strength by activated alumina. Using radiochemical techniques, the concentration of strontium and alumina, the presence of competing cations, total ionic strength, and pH are shown to be the parameters controlling sorption. The use of activated alumina for removing strontium from natural waters indicates that greater than 90 per cent removal can be obtained when the concentration of calcium and strontium is within the range of concentrations normally found in water used for human consumption. (Auth)

<135>

Bonniaud, R., P. Cohen, and C. Scabret, Attempt at Incorporating Concentrated Solutions of Fission Products in Glasses and Micax. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 33-36), 624 p. (Commissariat a l'Energie Atomique, France)

Data is shown demonstrating fixation of cesium in micaceous materials. (CWF)

<136>

Bose, H., Strontium 90 in Soils and Strontium 90 and Cesium 137 in Plants of the Territory of the GDR. 1967. 1969. SZS-7/69; 18 p. (Staatliche Zentrale fuer Strahlenschutz, Berlin, German Democratic Republic)

The results of Sr 90 determinations in soil and plant samples as well as the results of the Cs 137 determinations in mixed ashes of plants sampled in 1967 are presented. The course of contamination is figured back to the year 1961. The Strontium 90 contamination of meadow soils was 27.8 nCi/m² and that of arable soil was 31.4 nCi/m². For the first time a significant decrease (1966: 36.7 and 37.2, resp.) occurred. The investigation of the soil profiles of 4 meadow soils down to a depth of 50 cm did not show any increase of the Sr 90 concentration in the layers below 15 cm. The Sr 90 contamination of plants, which was between 41 and 82 percent of the values found in 1966, showed a more pronounced decrease than in the preceding year. No changes were observed for beets (body and tops). The Sr 90 content per kg dried matter was 1110 pCi/kg for cabbage (outer leaves), 787 pCi/kg for potato herb, 756 pCi/kg for red

clover, 705 pCi/kg for beet tops, 702 pCi/kg for lucern, 582 pCi/kg for grass, 288 pCi/kg for beets, 22 pCi/kg for green maize, 32 pCi/kg for potatoes, 31 pCi/kg for rye grains, and 29 pCi/kg for wheat grain. Fallout retention by above ground plant parts was between 23 and 49%. The portions of Sr 90 taken up by plants from soil as well as the observed ratios hardly differed from values of last year. The Cs 137/Sr 90 ratio decreased in rye grain from 3 to 2 and in wheat grain and potatoes from 3 to 1 and remained constant in grass (1) and potato herb (0.2). (Auth)

<137>

Bose, H., Strontium 90 and Cesium 137 Contamination of Plants and Soils on the Territory of the German Democratic Republic During 1966 to 1968. Part II.. 1970, May. Kernenergie, 13, 156-162 (Staatliche Zentrale fuer Strahlenschutz, Berlin, German Democratic Republic)

Strontium 90 soil contamination had its maximum (37 nCi/m²) in 1966 and was regressive in the following years of examination (1968: 28 nCi/m²). Highest Strontium 90 concentration was recorded in the soil layers of activity profiles routinely examined (0 up to 15 cm). Strontium 90 contamination of plants was approximately equivalent to Sr 90 fallout activity. Dry matter Sr 90 content of the plant parts above ground decreased in 1966 and 1967 with respect to the preceding year. It did not change in 1968 as compared with 1967 in spite of the low increase of fallout in the vegetational periods of 1968. The differences of Sr 90 total contamination of the various plants became smaller. In part, Cs 137 contamination of the plant materials examined showed greater regression than Sr 90. The Cs 137/Sr 90 ratio was approximately constant in grass, cabbages, and potato herb. Sr 90 surface contamination evaluations did not indicate the decrease to be expected in 1967, the test year of lowest Sr 90 fallout activity in the growing seasons. The minimum of Sr 90 fallout retention of the plant surfaces was in 1968 (8 up to 26 percent). Evaluations of the OR values and of the portions of Sr 90 deposited in the ground, that were taken up by the plants, did not essentially change with respect to the preceding test period. (Auth)

<138>

Bose, H., Strontium 90 in Soil and Strontium 90 and Cesium 137 in Plants on the Territory of the GDR. 1966. 1968, June. SZS-12/68; ORNL-tr-2152; 38p. (Staatliche Zentrale fuer Strahlenschutz, Berlin, German Democratic Republic)

The results of Strontium 90 determinations in soil and plant samples taken from the territory of the G.D.R. in 1966 as well as the results of Cesium 137 determinations in mixed ash samples of plants sampled in 1965 and 1966 are reported. The Strontium 90 concentration found in agricultural soils was 37.2 nCi/m² (1965:30.0). There was no difference of the Strontium 90 contamination of meadow soils (36.7 nCi/m²) between 1966 and 1965. The investigation of the soil profiles of 3 meadow soils down to a depth of 50 cm showed no increase of the Strontium 90 concentration in the layers below 15 cm. The Strontium 90 contamination of plants continued to decrease. In comparison to 1965 considerable differences were observed for lucern, rye grain, grass, potato herb, red clover and wheat grain. The Strontium 90 content per kg dried matter of these plant materials was 861.71, 1193, 1558, 1234 and 53 pCi, respectively. Compared to

<138> CONT.

1965 there was practically no change of the Strontium 90 content of green maize and beets (body and tops) whereas in potatoes and cabbage (head) the Strontium 90 content was about 90 percent. The estimated ratio of Strontium 90 surface contamination to Strontium 90 total contamination was between 38 and 56 percent. Fallout retention was between 12 and 45 percent. The portions of Strontium 90 taken up by plants from soil hardly differed from last year values. The Cesium 137/Strontium 90 ratio decreased in rye grain, wheat grain and potatoes from 4 (1965) to 3 (1966) and remained constant in grass (about 1). (Auth)

<139>

Bovard, P., Radioccontamination of Soils and Crops. 1970, May. Prot. Civ. Secur. Ind., 187, 10-13 (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Fontenay-aux-Roses, France)

The different origins of radioactivity are listed: natural radioactivity, fallout (Strontium 90 and Cesium 137) and radioactive industrial wastes. The cycles of radioelement transfer in the environment are described. The influence of water pollution (rainfall, irrigation) on contamination is discussed, together with the radionuclide distribution variation as a function of type of soil and organic matter. Next follows a study of the contamination of different crops either through the soil or directly, by radioactive aerosol deposition or by irrigation with contaminated water. Direct contamination is the main cause of contamination of the aerial parts of plants. The influence of technology on the contamination of food products is mentioned. The short-term risk is bound up with the presence of short-lived fission products (I 131) and the long-term risk with that of Sr 90 and Cs 137. (NSA)

<140>

Bovard, P., and A. Grauby, A Study of the Retentive Power of Soils under Natural Conditions for Radiostrontium. 1960. CEA-1751

Data concerning the movement of radiostrontium through soil profiles are evaluated in terms of the influence of soil structure, landscape and soil organic matter. (CWF)

<141>

Bovard, P., and A. Grauby, Study of Radioelement Migration in the In-Place Soils. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Commissariat a l'Energie Atomique, Service de Controle des Radiations et de Genie Radioactif, France)

The problems of medium protection against radioactive contamination hazards have led the Commissariat a l'Energie Atomique--Service de Controle des Radiations et de Genie Radioactif--to study the behaviour of ions in soils. There are many theoretical researches and laboratory works on the movement of radioelements in soil. But, with the difficulties for obtaining the same result in field, we have developed a simple direct study method of in place soils contamination. However, a principal drawback remains, the necessity to extrapolate from one or two reduced size samples, to a more or less large area. This is all the problem of sampling, which is not specific of our method. However, a choice justified by classical pedological

data, let us obtain a sufficient number of results and an accuracy which is suitable in regard of the carried on purpose. (Auth)

<142>

Bovard, P., A. Grauby, and J. Boyer, Retention and Accumulation of Ruthenium 106 + Rhodium 106 in Various Samples of Soils. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Commissariat a l'Energie Atomique, Service de Controle des Radiations et de Genie Radioactif, France; Centre de Recherches et d'Experiences de Genie Rural, France)

Ruthenium migration has been studied in three types of soils: silt, podzol and compost. Successively the effects of permeability and of exchange potentials in radioisotopes fixation have been shown. Exchange potential is not sufficient to explain soil behavior. Absorption indeed, seems clearly to depend on exchange capacity but other factors should be taken into account. Lixiviation tests have been made on the three soils types. The results show that a small part of the fixed ions is swiftly transported but that the major portion seems to be strongly fixed. Results obtained thus far correspond to given working conditions. Authors plan to carry on their work by modifying others parameters, soil moisture in particular. (Auth)

<143>

Bovard, P., A. Grauby, and A. Gravier, The Uptake of Strontium by Ryegrass. 1967. CONF-660405; Part of Aberq, B., Hunkate, F.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England (p. 453-465), 1051 p. (Commissariat a l'Energie Atomique, Department de la Protection Sanitaire, France)

Four forms of potassium fertilizers were applied to soil to evaluate the effect of radiostrontium uptake in ryegrass. In general, potassium applications enhance total radiostrontium uptake. (CWF)

<144>

Bovard, P., A. Grauby, and A. Saas, Chelating Effect of Organic Matter and Its Influence on the Migration of Fission Products. 1968. IAEA/SH-106/29; STI/PUB-190; CONF-680725; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Soil Organic-Matter Studies held in Vienna, Austria, July 15-19, 1968, (p. 471-495), 593 p. (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Cadarache, France)

Organic matter plays a vital role with regard to the radioisotopes introduced by fallout, irrigation water, or surface storage. The chelating effect of various types of organic matter on fission products is considered. The free functional groups (carboxylic, phenolic) are the cause of the fixation and complexing of radioisotopes. A mean order of complexing was established, which varies in its details depending on the type of organic matter concerned. The order established for humic acids, for example, is Ce greater than Fe greater than Mn greater than Co greater than or equal to Ru greater than or equal to Sr greater than Cs greater than I. In the case of fulvic acids this order is considerably more upset and is governed essentially by the functional groups present. A verification is presented of the results obtained for two

<144> CONT.

types of soil: a calcareous alluvial soil and a humo-ferruginous podzol. Organic matter plays an essential part in the movement of fission products in these two types of soil. Fulvic acids bring about the accumulation of fission products in the B sub h horizon of the podzol, and appear to be partially immobilized in the calcareous alluvial soil. Leaching of fission products, particularly ruthenium, by heavy rains occurs essentially in the form of fulvates. (Auth)

<145>

Bowen, H.J.M., and J.A. Dymond, The Uptake of Calcium and Strontium by Plants from Soils and Nutrient Solutions. 1956. Journal of Experimental Botany, 7, 256-272 (Medical Research Council Radiobiological Research Unit, Atomic Energy Research Establishment, Harwell, Berkshire, England)

The relative uptakes of strontium and calcium in tomato plants were measured after growing in nutrient solutions containing molar Ca/Sr ratios from 2/1 to 4000/1. (CWF)

<146>

Bowen, V.T., V.E. Noshkin, and H.L. Volchok, Can Land Run-Off be a Major Vector of Fallout to the Oceans?. 1970. HASL-217; Part of Hardy, E.B., Jr., and Rivera, J. (Eds.), Fallout Program Quarterly Summary Report, September 1-December 1, 1969, (p. I.119-I.127) (Health and Safety Laboratory, U.S. Atomic Energy Commission, New York, NY; Woods Hole Oceanographic Institution, Woods Hole, MA)

Available data from several ocean areas which are especially favorable in contributing a significant land run-off of fallout radionuclides indicates that land run-off is not a major source of radiocontaminates in oceanic bodies of water. (CWF)

<147>

Bradford, G.R., F.L. Bair, and V. Hunsaker, Trace and Major Element Contents of Soil Saturation Extracts. 1971. Soil Science, 112, 225-230 (University of California, Department of Soil Science, Riverside, CA)

Soil extracts from sixty-eight soil samples, representative of thirty soil series in California were analyzed for trace and major elements. (CWF)

<148>

Brat, S., and K. Balu, Suitability of Potassium Bentonites for the Removal of Cesium(+1) and Strontium(+2) Ions. 1972. BARC-606; 11 p. (Bhabha Atomic Research Centre, Bombay, India)

The naturally occurring bentonites (viz. Bihar bentonite, Rajasthan bentonite, and Saurashtra bentonite) of Indian origin were converted to the potassium form by continuously boiling these bentonites with 1M KCl solution in a pyrex glass flask at evolution temperature and atmospheric pressure for a period of 40 days. The converted K(+1) bentonites were studied for their various mineralogical and sorptive properties using Cs(+1) and Sr(+2). These converted K(+1) bentonites were found quite suitable for the uptake of Cs(+1) and Sr(+2) ions. (auth)

<149>

Brat, S., and K. Balu, Transformation of Indian Bentonites and Their Utilization in Radioactive

Waste Treatment. 1971. BARC-563; 22 p. (Bhabha Atomic Research Centre, Bombay, India)

Three Indian bentonites: Bihar bentonite, Rajasthan bentonite, and Saurashtra bentonite were transformed by continuously boiling them with 1 M KCl (CH₃COO)₂ in pyrex glass flasks at atmospheric pressure and boiling solution temperature for a period of 45 days. The products obtained were studied for their mineralogical and sorptive properties. It was concluded that the cation exchange or sorption capacity of a bentonite is decreased considerably on boiling continuously with 1M KCl(CH₃COO)₂. Though the concentration of K(+2) ions increased in the case of transformed bentonites, the Mg(+2) ions were not going to the exchange positions. It was also concluded that the best method is to convert natural bentonite to the sodium form by repeated treatment (at room temperature and atmospheric pressure) with 1M sodium chloride and then use the sodium bentonite for the uptake of radioactive ions such as Cs(+1), Sr(+2) and Mn(+2) present in liquid wastes. (auth)

<150>

Brauns, L.M., Radioactive Contamination of Soils and Plants by Fission Products. 1960. Bot. del. Inst. Nacl. Invest. Agron. (Madrid), 20(43), 259-285

Research work on the agricultural aspects of contamination, arising from the use of nuclear energy, is reviewed and summarized. Factors governing local and worldwide distribution and deposition of fission products are examined. Fission products once deposited contaminate soils and plants; the latter absorb those products either directly (floral, foliar and stem-base absorption) or indirectly (root absorption from a contaminated soil). Factors influencing all these processes are studied. (Auth) (CWF)

<151>

Brendakov, V.F., A.V. Dibtseva, V.I. Svishcheva, and V.N. Churkin, Vertical Distribution of Fission Elements in Some Types of Soils in the USSR. 1968, October. At. Energ. (USSR), 25, 331-332

Vertical distribution of debris elements in USSR soils was studied in various landscape regions in order to determine isotopic penetration into the soil surface. The mean laboratory errors in determining radioactive isotopes are 5 to 10 percent for Cs 137, 10 to 20 percent for Ce 144 and Ru 106, and 20 to 30 percent for Sb 125. Tabulated studies of the vertical distribution profile of total beta activity in soils in southern districts showed a rapid decrease of fragments in depth in dense red earths which are represented by argillaceous soils enriched with iron oxides. A maximum penetration of isotopes was observed in brown soils. Data on vertical distribution of isotopes on a mountainside measured in the Far East during 1964 showed the main concentration at 3 cm depth (with Sr 90-95 percent, Ce 144-96 percent, Cs 137-96 percent, Ru 234-90 percent, and Sb 125-90 percent). Studies of soils at depths below 33 cm revealed the presence of about 1 percent Sr 90 and rapidly disappearing while other isotopes were not found at such depths. (NSA)

<152>

Brendakov, V.F., A.V. Dibtseva, V.I. Svishcheva, and V.N. Churkin, Vertical Distribution and Evaluation of the Mobility of Fission Products in

<152>

<152> CONT.

Certain Soil Types of the Soviet Union.
A-AC-82/G/L-1258: AEC-tr-7030; (p. 152-156)

Samples of two types of undisturbed Russian soil, in 3 mm thick layers, were collected and examined during 1963 to 1966 to determine the vertical distribution and mobility of the following fission products Ce 144, Cs 137, Ru 106, Sb 125, and Sr 90. The results showed over 76 percent of all the radioisotopes were in the top 29 mm soil layer with only traces below a depth of 150 mm and that the transfer of the bulk of the radioisotopes did not exceed a few mm per year (NSA)

<153>

Brendakov, V.F., A.V. Dibtseva, V.I. Svishcheva, and V.N. Churkin, Vertical Distribution of Fission Elements in some Soils of the USSR. 1968. At. Energ. (USSR), 25, 1134-1136 (Not given)

An investigation into the vertical distribution of fission elements in soils of the Soviet Union has been conducted in various geographic zones with the object of determining the depth of isotope penetration into the soil cover. The methods of sample selection, their preparation for analysis, and fission element determinations are cited. (Auth)

<154>

Brendakov, V.F., S.V. Iokhel'son, and V.N. Churkin, Potassium, Radium, and Thorium Contents in Caucasian Soils. 1967, January. Pochvovedenie, 1, 41-47

The distribution of natural radioactive elements in the upper layer of Caucasian soils is discussed. A method of collecting and analyzing soil samples is described. Schematic maps of potassium, radium and thorium distribution in the upper layer of Caucasian soils are presented. (Auth)

<155>

Brown, D.A., B.E. Fulton, and R.E. Phillips, Ion Diffusion. I. A Quick-Freeze Method for the Measurement of Ion Diffusion in Soil and Clay Systems. 1964. Soil Science Society of America Proceedings, 28, 628-632 (University of Arkansas, Department of Agronomy, Fayetteville, AR)

The method combines a radioisotope-tracer technique for measuring ion distribution by quick-freezing the exchange medium and sectioning it into 50 micron segments with a refrigerated microtome. Ten-50 micron sections were placed in separate counting pans for a quantitative radiation assay. From these data the distribution resulting from ion diffusion in montmorillonite and kaolinite clays and Sharkey and Dundee soils was obtained. (CWF)

<156>

Brown, D.A., R.E. Phillips, L.O. Ashlock, and B.D. Fuqua, Effect of Aluminum (3) and Hydrogen (1) upon the Simultaneous Diffusion of Strontium 85 and Rubidium 86 in Kaolinite Clay. 1968. Clays and Clay Minerals, 16, 137-146 (University of Arkansas, Department of Agronomy, Fayetteville, AR)

The effect of varying concentrations of Al and H ions upon the simultaneous diffusion of Sr 85 and Rb 86 was measured in salt-free aliquots of clay having different Al:H ratios. (Auth) (CWF)

<157>

Brown, R.E., R.E. Franklin, and R.H. Miller, Reactions of Cerium 144 in Solution and Suspensions of Soil Humic Acid and Bentonite. 1969. Soil Science Society of America Proceedings, 33, 677-681 (Ohio State University, Columbus, OH; Ohio Agriculture Research and Development Center, Wooster, OH)

A study was made of the formation of radiocolloids by Ce 144 and the adsorption of Ce by equilibrated suspensions of humic acid, bentonite clay, and a mixture of these two colloids saturated with either Ca or K and H. The availability of Ce in these suspensions was measured using excised roots. (Auth) (CWF)

<158>

Brown, R.E., D.W. Pearce, J.H. Horton, Jr., and C.M. Patterson, Experience in the Disposal of Radioactive Wastes to the Ground at Two Production Sites. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 95-101), 624p. (Hanford Laboratories, Richland, WA; E.I. du Pont de Nemours and Company, Inc., Savannah River Plant, Wilmington, DE)

Problems of disposal of radioactive wastes at the Hanford, Washington, and Savannah River production sites are discussed. (CWF)

<159>

Brownell, J.R., and A. Lauchli, Measurement of Beta-Emitters in Plant Material with Cherenkov Radiation--Correction of Color-Quenching. 1969, November. Int. J. Appl. Radiat. Isotop., 20, 797-798 (University of California, Davis, CA)

It is stated that Cerenkov radiation is used routinely in the authors' laboratory for measuring the gamma-emitters Rb 86 and Cl 36 in intact plant material. In such work information is also needed on total contents of non-radiative ions. For determining both total and radioactive Rb a nitric acid ashing procedure is adopted, and this leads to a yellow colored digest which is a source of color-quenching in Cerenkov radiation measurement. Quenching in liquid scintillation counting is corrected by automatic external standardization, and it was considered that such standardization should also be applicable to the correction of color-quenching with Cerenkov radiation. Some tests with Rb 86 in plant material are described. Without external standardization count rates for plant samples indicated recoveries of approximately 50 percent, but with external standardization recoveries were about 100 percent. Recommendations are also made with regard to soft Gamma-emitters such as Cl 36. (Auth)

<160>

Bruce, R.S., and R.S. Russell, Agricultural Consequences of Releases of Radioactivity From Nuclear Installations into the Atmosphere. 1970. Health Physics, 19, 86 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

At the Second Congress of the International Radiation Protection Association the authors suggested that it was very unlikely the contamination by deposition of strontium 90 from nuclear installations would ever be so great that uptake from the soil of

<160> CONT.

radiostrontium would cause the diet to be contaminated to an unacceptable level. (CWF)

<161>

Bruland, K.W., M. Koide, and E.D. Goldberg, Comparative Marine Geochemistries of Lead 210 and Radium 226. 1974. UCSD-34-P-84-X-8; 15 p. (Scripps Institution of Oceanography, La Jolla, CA)

The Ra 226 and Pb 210 concentrations in Gulf of California and Eastern Pacific seawaters appear to be governed by the extents of upwelling and by the consequential biological productivities. The residence times of Ra 226 and Pb 210 in the highly productive Gulf of California surface waters are calculated to be a few months and less than a month, respectively, on the basis of upwelling rates. (Auth)

<162>

Bryant, E.A., G.A. Cowan, W.R. Heald, R.G. Menzel, R.F. Reitemeyer, J.E. Sattizahn, and B. Warren, Biological Availability of Strontium 90 from Atomic Tests. 1960. Science, 132, 327-330 (Los Alamos Scientific Laboratory, Los Alamos, NM; U.S. Department of Agriculture, Soil and Water Conservation Research Division, Beltsville, MD, U.S. Atomic Energy Commission, Division of Biology and Medicine, Washington, DC)

A detailed report on solubility of strontium 90 in fallout is presented. Engineering features of the devices as well as location and environment of the detonations determine the degree of water soluble strontium 90. In general the shots of highest yield produce debris of lowest solubility. (CWF)

<163>

Buchholz, J.R., W.H. Adams, C.W. Christenson, and E.B. Fowler, More on the Plutonium Particle Size Problem. 1971. LADC-12898 (Los Alamos Scientific Laboratory, Los Alamos, NM)

The problem concerning the Pu particle size in soil and its effect on soil analysis is discussed. (CWF)

<164>

Buchholz, J.R., W.H. Adams, C.W. Christenson, and E.B. Fowler, Summary of a Study of the Uptake of Plutonium 239 by Alfalfa from Soils. 1971. LADC-12897 (Los Alamos Scientific Laboratory, Los Alamos, NM)

The plant uptake of plutonium from the contaminated Palomares, Spain, soil as well as some soils from various parts of the USA was carried out. The discrimination ratio as defined by the ratio of the disintegration of Plutonium 239 per gram of ash to the disintegration of Plutonium 239 per minute per gram of dry soil was in the vicinity of 10 (E-3) to 10 (E-6). (CWF)

<165>

Bukovac, M.J., and S.H. Wittwer, Absorption and Mobility of Foliar Applied Nutrients. 1957. Plant Physiology, 32, 428-435 (Michigan State University, Department of Horticulture, East Lansing, MI)

The absorption, transport and mobility of foliar applied radioactive isotopes of rubidium, sodium, potassium, phosphorus, chlorine, sulfur, zinc, copper, manganese, iron, molybdenum, calcium, strontium, and

barium were determined with the bean as the experimental plant. Using as a criterion the percent of the foliar applied radioactive isotope recovered in non-treated plant parts, and autoradiography to portray gross distribution in the plant it was found that rubidium, sodium and potassium were the most readily absorbed and most highly mobile. Calcium, magnesium, strontium, and barium while absorbed by the leaf were not exported from the leaf and were considered immobile. Phosphorus, chlorine, sulfur, zinc, copper, manganese, iron, and molybdenum were intermediate with decreasing mobility in the order given. (Auth)

<166>

Bunker, C.M., and C.A. Bush, Radioelement Composition of Surface Soil in Adams County, Colorado. 1968. U.S. Geol. Surv. Prof. Pap., 600-B, B71-B75 (U.S. Geological Survey, Denver, CO)

Eighty-three samples collected from the Bennett, Manila, Horse, and Sunnydale 7 1/2 minute quadrangle areas near Denver, Colorado, were analyzed to determine the radioelement content and distribution. (CWF)

<167>

Cantillon, G., R. Kirchmann, and O. van der Borcht, Radiomanganese and Radiocobalt Fixation by Sediments, Fauna, and Flora in the Meuse, Downstream from the Franco-Belgian Ardennes Power Station. 1970. CONF-690918-(Vol. 1); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 127-163), 684 p. (Institut d'Hygiène et d'Epidémiologie, Brussels, Belgium)

The Meuse is used to supply a large section of the Belgian population with water. It is therefore necessary to be sure of the quality of this water and to analyze not only the water itself, untreated and filtered, but also samples of various sorts liable to act as indicators. This paper describes a program of samplings from muds, plants, and aquatic animals and gives the results obtained between 1965 (date previous to the start-up of the power plant) and the end of 1968. Results of experiments aimed at determining the Mn and Co fixation capacity of sediments, and the fixation and desorption of Mn 54 and Co 60 in aquatic mosses, are presented and discussed. (Auth)

<168>

Carach, J., and S. Caupka, Influence of the Radioactive Fallout on the Strontium 90 Level in Wheat in 1963 to 1965. 1967. Biologia (Bratislava), 22, 422-430

A direct relationship between the amount of Sr 90 in the fallout which occurred during the vegetation period of wheat and its content in the wheat was observed. The content of Sr 90 as determined at Jaslovské Bohunice was 51 percent higher in 1964, and 67 percent higher in 1965 than in Bratislavan wheat. Theoretical calculations made on the basis of the fallout agreed well with experimental results. (Auth)

<169>

Carfi, N., and L.R. Dugnani, Polonium 210 in Italian Tobacco. 1968. CONF-660920-2; Part of Snyder, W.S., et.al. (Eds.), Proceedings of the 1st IRPA Congress on Radiation Protection held in Rome, Italy. Pergamon Press Inc., New York, New York, Part 2, (p. 1097-1098) (Laboratori CISE,

<169> CONT.
Milan, Italy)

It is known that Po 210 contained in tobacco is volatile at the temperature of a burning cigarette. Hence a radiation hazard from Po 210 may arise for a smoker's bronchial epithelium. Hence measurements of Po 210 were started in most popular Italian cigarettes. A later stage of the work will consider the tobacco from some Italian regions. Polonium was extracted from tobacco samples by a wet ashing procedure and plated on nickel discs. The discs were mounted on ZnS phosphors and the alpha activity was counted. The polonium alpha spectrum was measured by an ionization chamber. The method can be simply carried out, but difficulty arises from the low-background alpha counting necessary for determining accurately the minute quantities of Po 210 (of the order of 10 (E-2) pCi). (Auth)

<170>

Carlile, B.L., Use of Synthetic Polymers in Soil Waste Disposal Systems. 1968, November 5. BNWL-SA-2016; 7 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

In the safe operation of reactors, it is necessary to have an emergency facility for the disposal of the water from the primary loop in the event of failure or rupture of the loop. Research on the disposal of this waste to the ground showed that activity reductions for cesium and strontium must be of 10 (E-6) magnitude. Treatment with low concentrations of alum or sodium sulfate with 0.1 ppm of some nonionic polymers would be effective in reducing particle and radioactivity migration in primary loop waste disposal to the ground. (NSA)

<171>

Carlile, B.L., and B.F. Hafez, Soil Radionuclide Adsorption and Particulate Filtration in an Nitrogen Area Soil. 1967. BNWL-CC-995; 16 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Interim experimental results are reported from an investigation of the extent of radionuclide movements, both ionic and particulate, from a Hanford ground disposal facility designed for disposal of radioactive waste coolant generated in the event of a reactor primary loop failure incident. Laboratory soil column investigations with high activity Cs 137 and Sr 90 solutions showed breakthrough values to be appreciably higher than previously extrapolated predictions for the soils. From the breakthrough pattern obtained in the initial phase of this study, it was evident that some phenomena other than ion exchange was responsible for this effluent activity. The three possible mechanisms of activity transportation are ionic solution transport, diffusive movement, and colloidal or particulate migration. Since only the latter mechanism could result in the breakthrough pattern obtained in this study, the possibility of particulate migration was investigated, and preliminary results are reported. (NSA)

<172>

Carroll, D., Ion Exchange in Clays and Other Minerals. 1959, June. Bulletin of the Geological Society of America, 70, 749-780

Ion exchange in clays and other minerals is dependent on the crystalline structure of the

mineral and on the chemical composition of any solution in contact with the mineral. The structures of clay minerals and zeolites are briefly described to provide a background for the discussion of their ion-exchange reactions. Ion exchange in these minerals is a reversible chemical reaction that takes place between ions held near a mineral surface by unbalanced electrical charges within the mineral framework and ions in a solution in contact with the mineral. Generally the excess charge on the mineral is negative, and it attracts cations from the solution to neutralize this charge. The chemical reactions in ion exchange follow the law of mass action, but the reactions are restricted by the number of exchange sites on the mineral and by the strength of the bonding of the exchangeable cations to the mineral surface. Titration of H-clays with bases shows that montmorillonite and "illite" behave like a mixture of two or three different acids, whereas kaolinite, with an indefinite number of exchange sites, behaves like an indefinite number of acids. Ion-exchange capacity is measured in chemical equivalents of base adsorbed at pH 7. Each clay mineral has a range of exchange capacities because of differences in structure and in chemical composition. The ranges (in milliequivalents per 100 grams) are kaolinite, 3-15; halloysite (2H₂O), 5-10; halloysite (4H₂O), 40-50; montmorillonite, 70-100; "illite," 10-40; vermiculite, 100-150; glauconite, 11-20; attapulgite, 20-30; and allophane, 70. The common metallic cations found in exchange positions in clay minerals are Ca(+2), Mg(+2), Na(+1), and K(+1). At low pH values H(+1) replaces other cations. The order of replaceability of the common cations has been found to be: Li(+1) less than Na(+1) less than K(+1) less than Rb(+1) less than Cs(+1) and Mg(+2) less than Ca(+2) less than Sr(+2) less than Ba(+2). Bivalent cations enter the exchange sites preferentially to univalent cations. The common exchangeable cation in most clay minerals in soils is Ca(+2). Other exchange phenomena discussed are anion exchange, fixation of cations and anions by clay minerals, effect of environment on cation exchange, and the exchange capacity of zeolites, of rocks, of other minerals, of organic matter and organic complexes, and of amorphous mineral material. (Auth)

<173>

Cearlock, D.B., R.C. Routson, and C.A. Bryan, Mathematical Simulation of Groundwater Transport of Radionuclides at Hanford. 1970, August. BNWL-SA-3494; CONF-700827-1; Part of Proceedings of the 18th Annual Specialty Conference held in Minneapolis, Minnesota, August 19-21, 1970, (24 p.) (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

A method for predicting the distribution and movement of radioisotopes in heterogeneous subsurface environments is being developed to improve understanding of the radiological effects of environmental waste disposal practices at Hanford. The transport equation used to predict the time-dependent, concentration distribution in saturated and unsaturated soils is discussed. Experiments performed to determine the effects of concentration of solution macroions on radioisotope adsorption, particularly Sr adsorption, and to obtain ion exchange data are described. Data on the energy potential of water in the Hanford soil were obtained to study the deep percolation of rainfall. The tritium content of deep well waters was measured to study the characteristics of the confined aquifer, the interrelations between

<173> CONT.

the surface and confined aquifers, and the effects of Hanford operations on the water quality in the confined aquifer. Finally a method for developing a computer program for visually displaying the ground water contours and flow paths for the measured aquifer conditions is described. (NSA)

<174>

Cerrai, E., A. Scaroni, and C. Triulzi, Some Bentonite Clays for Decontaminating Water Containing Radioactive Cesium and Strontium. 1960. *Energia Nucleare*, 7, 253-259 (Laboratori CISE, Milan, Italy)

Mixtures of ordinary and activated bentonite were found to be effective in the decontamination of liquids containing radiocesium and strontium. (CNF)

<175>

Chadwick, R.C., and A.C. Chamberlain, Field Loss of Radionuclides from Grass. 1970. *Atmos. Environ.*, 4, 51-56 (Atomic Energy Research Establishment, Harwell, Didcot, Berkshire, England)

Solutions of Sr 85, Cr 51, and Pb 210 were sprayed onto grassland, and the initial retention by the herbage and subsequent rate of field loss by weathering were measured. A similar experiment was also done with a spray containing a suspension of 1 μ m diameter polystyrene particles, tagged with Cr 51 in insoluble form. The activity initially retained by the herbage was on the average 40 per cent of that applied in the spray. The subsequent field loss corrected for radioactive decay gave retention half lives of Sr 85 as chloride of about 19 days in summer and 49 days in winter. The rate of loss of Cr 51 as chromate was not greatly different from that of Sr 85, and similar results also were obtained in the single experiment with tagged particles, but the rate of field loss of Pb 210 appeared to be somewhat less. (Auth)

<176>

Chamel, A., The Fixation and Migration of Potassium 42 Applied to the Leaves of Corn. 1970. CEA-CONF-1517; CONF-700327-1; Part of Proceedings of the 6th International Colloquium on Plant Analysis and Fertilizer Problems held in Tel Aviv, Israel, March 13-17, 1970, (12 p.) (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Saclay, France)

The fixation and migration of K 42 in the form of KNO3 solutions applied to the leaves of corn was studied in corn of different ages. The results show that the age of the leaf has no effect on the fixation of K 42, but the migration of K 42 from the leaves is differentiated progressively with the development of the plant. The greatest part of the radioactivity is found in the stem of the leaf treated. A potassium deficiency in the nutritive milieu does not affect the fixation, but the migration decreases very sharply when the plants are cultivated in a K-deficient milieu. The temperature of the milieu surrounding the roots affects the fixation but less sharply than it affects the migration: both are less at low temperatures. (NSA)

<177>

Champlin, J.B.F., Transport of Radioisotopes by Fine Particulate Matter in Aquifers. 1970. Ph.D. Thesis: 199 p. (Georgia Institute of

Technology, Atlanta, GA)

The information required to explain the long-range movement of radioactive fission products from waste pits, fallout, and underground nuclear explosions, as well as that of other environmental pollutants was sought. Both (S)uff@uff theoretical and experimental investigations of the various phenomena that pertain to ion transport or retention by soils are included. The theoretical section delves into the interactions between solids in water that result from thermal forces, electrostatic charges, and van der Waals forces. The particle range considered is that of the large colloid to the finest silt. Sources of energy sufficient to cause breakage of adsorption bonds and the importance of the concept of additive bonding in the water are discussed. The important relationship between suspended particles and the "massive" granules making up the model aquifer is explored at some depth. In the experimental section, factors which influence either retention of radioactivity by the sand bed or transport of the activity through such a bed by micro-particles are considered. Correlation is sought between the phenomena observed experimentally and that predicted in the theoretical section. Casimir's correction to the theoretical van der Waals interactions is proposed to account for major changes in the particle retention ability of the sand bed when dispersants are included in the influent water. The future potential of such research, as well as some of the practical aspects of the results reported here is discussed. (Auth)

<178>

Champlin, J.B.F., and G.G. Eichholz, Movement of Radioactive Sodium and Ruthenium through a Simulated Aquifer. 1968, February. *Water Resour. Res.*, 4, 147-158 (Georgia Institute of Technology, Atlanta, GA)

Factors affecting the presence of measurable quantities of radioisotopes in ground water, which has passed through a large thickness of soil or porous rock, in locations where radioactive wastes are stored were studied. To investigate the contributions made by water to the transport of ionic materials through soils, radioactive solutions were injected into a model aquifer containing 725 kg of sand with dimensions of 1 x 2 x 0.25 m. As the radioactivity passed through the sand, its progress was followed by a collimated G-M tube situated on the exterior of the bed. The appearance of the radioactivity in the effluent, which marked the arrival of the Na front, was found to be correlated with an increase in suspended particulate matter, K, and Ca concentrations, and overall conductivity. Of particular significance was that portion of the radioactivity shown to be related directly to the filterable mass of particles in the effluent, despite the high solubility of the ion used. The results with Na were compared with those of similar tests on the movement of trivalent Ru, which is not soluble at the pH of the solutions used. Both the Na and Ru studies indicated that a significant amount of radioactivity was transported through the test bed on particulate matter which was large enough to be trapped on 0.45- μ membrane filters. (NSA)

<179>

Charnell, R.L., P.R. Fenske, N.L. Guinasso, Jr., W.R. Schell, and T.M. Zorich, Hydrologic Redistribution of Radionuclides around a Nuclear Crater. 1967, July. *NVO-1229-87*; 46 p.

<179> CONT.

(Isotopes, Incorporated, Palo Alto, CA)

A conceptual model for redistribution of radionuclides around a nuclear excavated crater has been formulated. This model relies on many simplifications to allow analysis of the entire hydrologic system around the crater at the same time. The model is separated in terms of three major regions: fallout zone; ground water zone; and crater rubble zone. The redistribution within each of these sections is treated separately. The entire redistribution of radionuclides is obtained by combining effects from all three sections. The model in its present form is general. It can be applied to many nuclear cratering detonations. The model must be evaluated and refined in terms of a specific cratering application. (Auth)

<180>

Charnell, R.L., T.M. Zorich, and D.E. Holly, Hydrologic Redistribution of Radionuclides around a Nuclear-Excavated Sea-Level Canal. 1969, September. Bioscience, 19, 799-803 (A. Teledyne Co., Palo, CA)

A brief discussion of the hydrologic redistribution of radionuclides deposited in the environment following nuclear excavation of a sea-level canal in Central America is presented. A simple yet comprehensive numerical model is presented by which estimates of the rates of removal of radionuclides from deposited fallout and from the effects and fallback can be made, as well as a diagrammatic model of the general hydrologic cycle is presented. The largest reservoir in the hydrologic cycle is the ocean-canal system where water is held in the form of a saline solution. Water leaves this reservoir by evaporation to lodge temporarily in the atmosphere and returns to the surface as precipitation. From the surface, water evaporates or satisfies soil moisture or vegetation requirements. Some of the water enters the ground-water system. Water returns to the ocean by runoff and flow from ground water. Volatile constituents travel all paths of the hydrologic cycle. Soluble radionuclides move with the water except during evaporation, but are retarded because of plant uptake and adsorption on soil and rock particles. The filtering action of soil and rock restricts the movement of particulate matter to surface water. Examination of the entire hydrologic redistribution regimen requires that the alteration of the hydrologic system be taken into account. The redistribution model can be applied to specific field conditions with the proper selection of values for the rates coefficients. (NSA)

<181>

Charreau, C., and L. Jacquinet, Use of Tritiated Water to Study Water Circulation in a Sandy Soil in Senegal. 1967. CONF-670641; STI/PUB-158; Part of Proceedings of a Symposium on the Use of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies held in Istanbul, Turkey, June 12-16, 1967, (p. 301-314) (Centre de Recherches Agronomiques, Bambev, Senegal)

A study was carried out in Senegal on the behavior, with respect to the soil solution, of a flow of water infiltrating a sandy soil under a constant head. The experimental set-up consisted of a cylindrical lysimeter 2 m high and 1 m in diameter. The initial water content of the soil was increased to near field capacity. A sheet of tritiated water 3

cm deep was then maintained on the soil surface. The drainage water was collected in 5-liter amounts and the radioactivity measured, in the laboratory. First the infiltration and drainage rates for dry and wet soil are compared. From examination of the curve showing variations in the concentration of tritiated water in the drainage water as a function of the amount of drainage water it can be seen that the tritiated water begins to appear in the drainage water before the water initially in the soil has been completely replaced. The concentration then increases rapidly and approaches the original value. From the shape of the curve it is concluded that the soil solution is not immediately displaced in its entirety by the applied water, even in very sandy soil; instead, there is an intermediate phase during which the two solutions present are progressively mixed. This phase involves a total of 102 mm of water, of which 42 mm is tritiated water. The mixing occurs within an 80-cm thick soil layer. Possible agronomic consequences of the processes studied are discussed. (Auth)

<182>

Chebota, M.Ya., Influence of Aqueous Extraction from Tree Leaves on the Migration of Manganese 54 in Various Types of Soils. 1968. Tr. Inst. Ekol. Rast. Zhivotn., 61, 26-30

Aqueous extracts from the leaves of ligneous species, in comparison with water, increased the migration capability of Mn 54 in a solution-soil system. However, their influence was not as great as the desorbing action of a 0.01 M solution of EDTA. The mobility of manganese under the influence of the extracts depended on the type of soil and was increased in a series: turf-meadow soil - black soil - red soil - turf-podzolic, horizon A sub 2. According to the extent of desorbing capability, the extracts were arranged: pine - birch - linden tree - cherry - aspen. (tr-Auth)

<183>

Chebota, M.Ya., Influence of Plant Extracts on the Mobility of Iron 59 and Cobalt 60 in Soil under Conditions of Dynamic Laboratory Experiments. 1971. Soviet Radiochemistry, 13, 756-759 (Not given)

Under the conditions of dynamic laboratory experiments, plant extracts (aqueous extracts from pine needles, linden and aspen leaves) increase the content of Fe 59 and Co 60 in the filtrate of soil columns in comparison with the control (lake water). The content of Fe 59 in column filtrates increases with increasing number of volumes of the solution passed through (in all the experimental variations). The content of Co 60 in the filtrate in the control is practically constant; in the variation with an extract from pine needles it increases with increasing number of volumes of the solution passed through, while in the variation with extracts from linden and aspen leaves it at first increases, but then remains practically constant. The solubilizing action of the extracts in general increases in the series: lake water < extract from pine needles < extract from linden leaves < extract from aspen leaves. In the variation with extracts, radioactive cobalt is uniformly distributed through the soil filter; in the control it is basically sorbed by the first soil layer. The content of iron 59 in all the experimental variations more or less uniformly drops along the layers of the soil filter. (Auth)

<184>

Chebotina, M.Ya., Entry of Yttrium 91 into Plants through the Leaf Surface. 1970. Ecology (USSR), 4, 350-352 (Institute of Plant and Animal Ecology, Sverdlovsk, USSR)

Experiments were conducted to study the entry of ionic and complexed Y 91 from the foliage into other plant parts. Capital variety pea seedlings grown in Knopp nutrient solution for 15 days were administered 0.02 ml of a solution of Y 91 YCl3 or YEDTA (2 uCi/plant). After 25 days the plant parts were separated and ashed and the radioactivity of the ashed material and nutrient solution determined. It was found that more than 95% of the radioyttrium was retained at the site of introduction on the foliage. The complexed form of yttrium had a greater migration ability than the ionic form. For the same relative weight of different plant organs the distribution of yttrium was approximately the same. It was concluded that radioyttrium introduced onto the leaf surface in either form is converted into the same transportable form on entry into the leaf. Elimination of radioyttrium from the plant root system into the nutrient solution was not detected. (SF)

<185>

Chebotina, M.Ya., Influence of EDTA on the Cobalt Mobility in Above Ground Pea Plants. 1968. Tr. Inst. Ekol. Rast. Zhivotn., 61, 55-57

The outflow of Co 60 from leaves and other organs of pea plants following root feedings with a solution of Cobalt 60-labeled CoCl2 was approximately three times greater than following feeding with a solution of Cobalt 60-EDTA. The relative distribution of cobalt in the main organs of the pea plants following uptake of either solution was the same. The transfer of cobalt from the nutrient solution to the root system of the plants was not revealed. (tr-Auth)

<186>

Chebotina, M.Ya., On the Properties of Desorptive Effects of Extracts on Leaf Fall. 1968. Tr. Inst. Ekol. Rast. Zhivotn., 61, 12-21

The desorbing action of extracts from the leaves of ligneous plants can be attributed to the content of organic substances (iron, cobalt) and cations capable of leaching microelements from the soil (strontium, cobalt). In the extracts studied, cobalt and manganese were mainly in true solution, yttrium however, was usually connected to colloids. The influence of low-molecular weight organic acids and amino acids on the mobility of the microelements can be compared with the influence of secondary vegetable products--humic and fulvic acid. (tr-Auth)

<187>

Chebotina, M.Ya., and N.V. Kulikov, Influence of Water-Soluble Decomposition Products of Grass Plants on the Absorption of Radionuclides in the Soil. 1973. Soviet Journal of Ecology, 4(1), 84-85 (Institute of Plant and Animal Ecology, Urals Scientific Center, USSR)

The decomposition products of dying plant life, interacting with the soil, change its chemical composition to a substantial degree and have a substantial influence on the processes of migration and redistribution of the chemical elements in the soil profile. In recent years experimental data have been obtained, confirming the fact that water-soluble substances of decomposing fallen

leaves of woody plants reduce the sorption of a whole series of radioactive isotopes in the soil and thereby increase their mobility in the soil-solution system. (Auth)

<188>

Cho, C.M., Use of Isotopes for Ionic Transport Studies in Soil. CONF-711213; IAEA/SM-151/48; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971, (p. 145-152) (University of Manitoba, Winnipeg, Manitoba, Canada)

Isotopic exchange reactions between labelled inorganic ions and the corresponding isotope in the solid phase of the soil matrix modifies the transport of the labelled ion from that of the natural isotope. The degree of modification is a function of the rate constant as well as the quantities in the respective phases. Experimental results of P 32 movement in several soils indicated that it always travelled more slowly than P 31. However, if the local concentration of P 31 was very high and shaped like a normal distribution curve, then the movements of P 31 and P 32 were very similar. A theoretical analysis of this behavior was carried out applying the dispersion and diffusion equations of P transport. The results indicated that the velocity of the center of mass and the diffusion coefficient of P measured by the P 32 in soil were all functions of the isotopically exchangeable phosphate in soil as well as the rate of P application. (Auth)

<189>

Christenson, C.W., Ground Disposal of Liquids. 1968, October. LA-DC-10004; Part of Basic Training Course in Management of Radioactive Wastes held in Rio de Janeiro, Brazil, October 14-25, 1968, 11 p. (Los Alamos Scientific Laboratory, Los Alamos, NM)

The disposal of liquid radioactive wastes to the ground is discussed as part of a basic course in radioactive waste management given in Rio de Janeiro, October 14 to 25, 1968. The factors which determine the feasibility of ground disposal, namely, the climate, geology, and hydrology of the disposal site, the composition of the waste solution, and the methods of disposal are explained. (NSA)

<190>

Christenson, C.W., and R.G. Thomas, Movement of Plutonium through Los Alamos Tuff. 1962. TID-7628 (Los Alamos Scientific Laboratory, Los Alamos, NM)

Soil profile analyses of plutonium showed that under field conditions movement in the Los Alamos tuff was detected to a depth of 28 feet. Movement was thought to occur chiefly along fissures in the soil structure. (CWF)

<191>

Chu, H.Y., Plutonium Determination in Soil by Leaching and Ion Exchange Separation. 1971, March. Anal. Chem., 43, 449-452 (U.S. Atomic Energy Commission, New York, NY)

A method to determine the levels of plutonium in 100-g samples of soil is described. The soil is leached with a mixture of nitric and hydrochloric acids in the presence of Pu 236 tracer. Plutonium in the leachate is converted to Pu (+4) with sodium nitrite and

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absorbed from 8N nitric acid onto Dowex 1-x4 ion exchange resin. Plutonium is removed from the exchanger and electroplated on a platinum disk. The plated disk is counted in an alpha spectrometer. The results obtained by leaching were found to be in good agreement with plutonium measurements of reference soils analyzed by complete solution of the sample. (NSA)

<192>

Chu, T.C., and C.H. Chenq, A Survey of Strontium 90 and Cesium 137 Concentrations in Taiwan Tea, 1969. Boken Butsuri, 4, 514-517

Samples of Taiwan tea were collected and investigated for Sr 90 and Cs 137 contents by radiochemical analysis in 1968. The average concentration obtained was 397 pCi/kg or 89.8 pCi/gCa for Sr 90 and 116.2 pCi/kg or 7.09 pCi/gCa for Cs 137. The ratio Cs 137/Sr 90 was found to be 0.29. A comparison with previous reports by different authors is given, and an intercomparison run of Sr 90 and Cs 137 concentration in diet sample is also included. (NSA)

<193>

Chulkov, P.M., L.N. Kurchatova, N.W. Yuzvuk, and O.A. Vadkovskaya, Presence of Strontium 90 in Soils and Vegetation in the Surroundings of Moscow. 1957. Soviet Soil Science, 4, 28-34

A survey of the soils in the vicinity of Moscow showed radiostromtium to be present in the upper layers of the soil horizons in the order of $1.6 \times 10(E-3)$ Ci/km². On a dry weight basis vegetation contained $4.5 \times 10(E-10)$ Ci/kilogram. (CWF)

<194>

Chupka, Sh., M. Petrasova, and I. Tsarakh, Contamination of Certain Objects of the Environment in Western Slovakia. 1969, May. Gig. Sanit., 5, 75-77 (Regional Sanitation Station, Bratislava, Czechoslovakia)

On the basis of results obtained from observations made during 1962 to 1967, an attempt was made to establish a relation between the density of radioactive precipitation and the contamination of soil, vegetation, and crop products. The average annual content of Sr 90 and Cs 137 in atmospheric precipitation, grass, alfalfa, and wheat, and the Sr 90 content of soil and overall annual atmospheric contaminations are presented in graphic and tabular forms. From the data, it is apparent that the general nature of the contamination levels for plants corresponds to the intensity of precipitation in relation to these radioisotopes. This evidence also bears witness to the prominent role of atmospheric fallout in the Sr 90 and Cs 137 contamination of the objects studied. The Sr 90 content of soil during 1964 was virtually constant at about 100 pCi/kg of anhydrous soil. On the basis of the results, it was possible to establish the degree of Sr 90 discrimination in relation to calcium by its migration in certain components of the food chain. This was particularly true of the milk-grass and meat-grass components. The data thus permit the observation that environmental contamination by Sr 90 and Cs 137 is basically related to atmospheric precipitation. (NSA)

<195>

Chute, J.H., R.A. Clapp, and J.P. Quirk, Alpha

Activity of Western Australian Soils and Wheats. 1970. J. Roy. Soc. West. Aust., 53, 37 (University of Western Australia, Nedlands, Australia)

Lateritic soils formed on the Precambrian shield of southwestern Australia have measured gamma activities in the range of 40 to 100 pCi/g from naturally occurring isotopes; whereas in soils formed on Mesozoic and Cainozoic coastal sediments the gamma activity seldom exceeds 20 pCi/g. The ash activity of wheat growing on the more active soils can be as high as 90 pCi/g. However, there is at least a three-fold variation in uptake of active isotopes depending on wheat variety. For the lateritic soils, there is a correlation between total gamma activity and both ironstone gravel content and the total Fe + Al in the soil. There is also some evidence for an activity dependence on present climate and rainfall. Although applied superphosphate fertilizer is high in natural radioactivity, it is not believed to have made a significant contribution to the measured gamma activity of the soil. (Auth)

<196>

Chuveleva, E.A., K.V. Chmutov, and P.P. Nazarov, The Ion-Exchange Sorption of Radioelements by Soils. III. The Dissociation Constant of the Carboxyl Groups in Humic Acid. 1962, April. Russian Journal of Physical Chemistry, 36, 432-433 (Institute of Physical Chemistry, Academy of Sciences, Moscow, USSR)

The apparent dissociation constants of humic acid, KB-4 cation exchanger, and SG-1 cation exchanger were determined by potentiometric titration. It was concluded that humic acid could be used as a solvent for the removal of ions from solutions between pH 3 and 5. (CWF)

<197>

Chuveleva, E.A., K.V. Chmutov, and P.P. Nazarov, The Ion Exchange Sorption of Radioelements by Soils. II. The Cerium-Calcium Ion-Exchange Equilibrium on Humic Acid. 1962. Russian Journal of Physical Chemistry, 36, 430-432 (Institute of Physical Chemistry, Academy of Sciences, Moscow, USSR)

The exchange equilibrium of Ce and Ca on humic acid was determined. (CWF)

<198>

Chuveleva, E.A., P.P. Nazarov, and K.V. Chmutov, The Ion Exchange Sorption of Radioelements by Soils. I. Sorption of Radiocerium by Chernozem. 1962. Russian Journal of Physical Chemistry, 36, 427-430 (Institute of Physical Chemistry, Academy of Sciences of the USSR, Moscow, USSR)

Study of the sorption of microquantities of cerium by chernozem, montmorillonite, and humic acid from sodium and calcium salt solutions has established that microquantities of cerium are mainly sorbed by the more active constituent of chernozem-humic acid and similar materials. (Auth) (CWF)

<199>

Chuveleva, E.A., P.P. Nazarov, and K.V. Chmutov, The Ion Exchange Sorption of Radioelements by Soils. IV. Complex Formation by Some Metal Ions with Humic Acid. 1962. Russian Journal of Physical Chemistry, 36, 738-741

Humic acid was found to complex ions of the rare-earth and alkaline-earth metals. Stability constants of humic acids with

<199> CONT.

yttrium, promethium, and calcium were given.
(CWF)

<200>

Clebsch, A., Jr., and A.E. Peckham, Research by the United States Geological Survey Related to the Movement of Radionuclides in the Earth Environment. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962, (p. 189-197) (U.S. Geological Survey, Washington, DC)

Geologic and hydrologic research by the U.S. Geological Survey related to the movement or retention of radionuclides embraces several scientific disciplines, a wide variety of geohydrologic terranes, and various types of radioactive materials. Field studies have been completed or are in progress at all the major nuclear energy installations in the United States where large releases of radioactivity have been made, either in the form of radioactive wastes or as the consequence of nuclear explosions. Much of this work is designed to develop an understanding of the influences of geologic and hydrologic features on radionuclide movement. Chemical studies include supporting services for field projects as well as research on reactions between radioactive substances and earth materials. Descriptive geochemical research on the distribution of stable elements, such as strontium, and naturally occurring radioactive elements, such as radium and uranium, has been a small but important part of the work. Theoretical fluid movement as they affect the transport and dispersion of radionuclides has emphasized the effects of the abundant departures in nature from idealized systems. Work related to the development of new techniques for disposal of wastes, such as deep-well injection, ultimate storage of fluids in cavities mined in rocks of low permeability, and storage of solids or fluids in salt, ranges from the compilation of broad summaries of the geology of geologic basins to detailed geologic and hydrologic investigations at the particular site. (NSA)

<201>

Cline, J.F., The Effects of Substrate Conditions on the Uptake Rate of Cesium 137 by Plants. 1969. CONF-670503; Part of Nelson, D.J. and Evans, F.C. (Eds.) Proceedings of the Second National Symposium on Radioecology, held in Ann Arbor, Michigan, May 15-17, 1967, (p. 547-552), 774p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Plants from marshy areas accumulate more Cs 137 than do plants growing in nonflooded terrain. This higher accumulation in plant tissue has been explained as direct uptake of the Cs 137 by the roots prior to any attachment of the radionuclide to the soil colloid. The present study shows that Cs 137 moves freely from soil colloids to roots when both are suspended in turbulent nutrient solution. Drying the contaminated clay at 100 C prior to suspending it in the nutrient solution did not decrease the rate of uptake by the plants, and this rate of accumulation was the same as in plants grown in solution with Cs 137 added as the ion. (Auth) (CWF)

<202>

Cline, J.F., Plant Uptake of Strontium 90 and Cesium 137 from Field Plots. 1963. HW-76000; Part of the Hanford Biology Research Annual Report for 1962 (Hanford Laboratories, Richland,

WA)

Time after the soil was contaminated had negligible effect on the percent of Sr 90 removed from a local basic soil by a crop. Cesium 137 accumulation in bean plants was not depressed by the addition to the soil of various quantities of K. Relative uptake of Cs 137 was approximately 100-fold less than Sr 90 and Sr 85. (Auth)

<203>

Cline, J.F., Uptake of Americium 241 and Plutonium 239 by Plants. BNWL-714; (p. 8.24-8.25) (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Concentrations of Am 241 were 20-30 times greater than those of Pu 239 in plant tissues grown on substrates containing equal amounts of the radioisotopes. Americium was more toxic than plutonium to growing roots. It was bound tightly to soil particles but showed some movement with irrigation water, especially in basic soils. (Auth)

<204>

Cline, J.F., and M.W. Maqula, Effect of Clay Particles on Uptake of Cesium by Plants. BNWL-280; (p. 107-108) (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Cesium 137 moves easily from bentonite clay particles to plant roots when a complete and agitated water bridge connects the particles to the root. (Auth)

<205>

Cline, J.F., and W.H. Rickard, Influence of Soil Sodium on Plant Uptake of Calcium 45, Strontium 85, and Cesium 137. 1965. BNWL-122; (p. 168-169) (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

The concentration of Sr 85 and Ca 45 in plants was reduced by 50 percent when grown in a high sodium soil. Cesium 137 concentration was reduced 25 percent by the same treatment. (Auth)

<206>

Cline, J.F., and W.H. Rickard, Radioactive Strontium and Cesium in Cultivated and Abandoned Field Plots. 1972. Health Physics, 23, 317-324; CONF-710501-1; Part of Nelson, D.J. (Ed.), Proceedings of the Third National Symposium on Radioecology held in Oak Ridge, Tennessee, May 10-12, 1971, (p. 218-212), 1268 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Strontium 90 and Cs 137 added to surface soil of small field plots 16 and 8 yr ago respectively were measured in tissues of barley, alfalfa, radishes, and beans. Five years ago these plots were abandoned and allowed to be naturally colonized by the annual weeds, cheatgrass and mustards, characteristic of early secondary plant succession in the semiarid steppe region of southeastern Washington. After 16 yr, Sr 90 was still available for plant uptake. The major loss was attributed to physical decay. Less than 2% of the estimated loss could be assigned to plant harvest and cultural practices. Strontium 90 was taken up by plants up to 100 times more effectively than Cs 137. After 8 yr, 70% of the added Cs 137 remained in the upper inch of untilled soil. In tilled soil Cs 137 was concentrated at the

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tillage depth of 5 to 6 in. After 16 yr, Sr 90 was distributed throughout the upper 10 in. of untilled soil and tended to form an accumulated front 5 to 6 in. deep. In the tilled soil, Sr 90 was scattered throughout the upper 10 in. and some had probably moved deeper into the underlying gravel. (Auth)

<207>

Coleman, W.T., Accumulation of Cerium, Yttrium, and Cesium in Plants as Affected by Their Soil Chemistry and the Aeration of the Soil. 1966. TID-22715: 34 p. (University of California, Department of Soils and Plant Nutrition, Riverside, CA)

Relative cesium adsorption and fixation at different cesium levels were investigated for a number of soils and minerals. Potassium and ammonium salts removed greater quantities of adsorbed cesium from micas than Na or Ca chloride salts. However, the reverse was true for Cs desorption from vermiculites and hydrobiotites. The effects of K, NH₄, and NaNO₃ on uptake of cesium in plants is presented. (CWF)

<208>

Coleman, W.T., D. Craig, and R.J. Lewis, Ion Exchange Reactions of Cesium. 1963. Soil Science Society of America Proceedings, 27, 287-289 (University of California, Riverside, CA; North Carolina State College, Raleigh, NC; University of North Carolina, Chapel Hill, NC)

Column leaching experiments with 0.001N CsCl with 1N KCl or CaCl₂ showed Cs sorption by a number of clays to be much larger from Ca than from K solutions. The sorption affinity of Cs relative to the complementary ion corresponded with that found by others for the Cs-K ion pair, but in Cs-Ca systems the Cs was sorbed to a larger extent than would have been expected from the results of experiments where Cs-Ca ratios in the equilibrium solution were not so small. While all except a very small proportion of the sorbed Cs was displaced on leaching with 1N KCl, some 36 times as much remained after leaching with equal volumes of 1N CaCl₂. Vermiculite sorbed very large amounts of Cs (about 1/3 of exchange capacity) from 0.001N CsCl-1N CaCl₂. The sorbed Cs was largely "fixed" against exchange with 1N CaCl₂. This suggests that Cs contained in interlayer spaces of vermiculite results in interplanar distances which will admit K but not Ca. (Auth)

<209>

Coleman, W.T., and F.H. Le Roux, Ion Exchange Displacement of Cesium from Soil Vermiculite. 1965. Soil Science, 99, 243-250 (University of California, Citrus Research Center, Riverside, CA)

Exhaustive leaching of radiocesium-saturated samples of soil size separates containing vermiculite and hydrobiotite gave elution curves which suggested that Cs displacement from <20 micron fractions was governed by an exchange process. The slow removal of Cs from interlayer sites was regarded as due to very large sorption affinity rather than to small diffusion coefficients. Apparent exchange coefficients for Hg-Cs, calculated from the elution curves, were on the order of 10(4), with Cs preferred. Batch experiments with 2-5 or 5-20 micron soil material in N or 0.1 N HgCl₂ gave apparent exchange coefficients for Hg-Cs on the order of 10(3) when Cs was being adsorbed and of 10(4) when Cs was being displaced. Potassium ions displaced

radiocesium from interlayer spaces of soil vermiculite-hydrobiotite far more effectively than did Na or alkaline earth cations. Apparently, plate separation in Cs-saturated material is sufficient to admit K, thus making K-Cs exchange different from K-NH₄ or NH₄-K exchanges. Trace amounts of Cs were very slowly eluted by HgCl₂ from silt-size soil vermiculite-hydrobiotite. However, rates of removal were again consistent with ion exchange as being rate-controlling, with the slow removal due to very small saturation with Cs. (Auth)

<210>

Coleman, W.T., R.J. Lewis, and D. Craig, Sorption of Cesium by Soils and Its Displacement by Salt Solutions. 1963. Soil Science Society of America Proceedings, 27, 290-294 (University of California, Riverside, CA; North Carolina State College, Raleigh, NC; University of North Carolina, Chemistry Department, Chapel Hill, NC)

Cesium was sorbed by montmorillonite, illite, and kaolinite in quantities corresponding to exchange saturation and was displaced readily on leaching with 1N KCl or CaCl₂. Vermiculite and heated (600 degrees C., 12 hours.) K-montmorillonite bound Cs tightly against displacement by CaCl₂ and AlCl₃, but not by KCl or NH₄Cl. Prolonged leaching with 1N KCl removed 97.5 percent of the Cs sorbed by heated K-montmorillonite, while 1N CaCl₂ eventually displaced 88 percent. Potassium and Rb sorbed on vermiculite were displaced more rapidly by Ca or Hg than by monovalent ions, but this was not the case with heated K-montmorillonite. The exchange-displacement behavior of Cs on vermiculite and heated K-montmorillonite suggests that this ion is unique in that its sorption in interlayer spaces leads to interplanar distances which admit K and NH₄ ions but greatly restrict the entry of Ca. Cesium, then, is not expected to follow the "fixation-release" rules that have been developed for K and NH₄. Heated montmorillonite samples leached with mixtures of CsCl and other salts sorbed more Cs when the complementary ion was Ca or Al than when it was K or NH₄. Differences were especially pronounced at low equivalent fractions of Cs in the leaching solution, showing a larger preference by exchange sites for Cs over divalent than over monovalent ions. Apparent "specific sorption" of Cs against exchange with CaCl₂ occurred at quite large Cs saturations. (Auth)

<211>

Collander, B., Selective Absorption of Cations by Higher Plants. 1941. Plant Physiology, 16, 691-720 (University of Helsinki, Botanical Institute, Helsinki, Finland)

The uptake and translocation of sodium, potassium, rubidium, magnesium, calcium, strontium, manganese, lithium, cesium and copper in 20 phanerogams representing different ecological types from complete nutrient solutions were carried out. (CWF)

<212>

Collins, H.A., Selective Absorption and Accumulation of Strontium by Plants. 1969. ORO-3459-4: 39 p. (Tuskegee Institute, Tuskegee, AL)

This investigation was designed primarily to determine the selectivity of plant species, both cultivated and non-cultivated, for absorbing and accumulating strontium from two soil types differing markedly in chemical and

<212> CONT.

physical properties. Characteristics of these soils appear in detail in the introductory section of this report. In addition to the primary objective, experiments were designed to determine the effects of exogenous applications of strontium and of a nitrogen, phosphorus and potassium fertilizer mixture on absorption and subsequent accumulation of stable and radioactive strontium by plants. A total of 46 different plant species representing some 13 plant families were included in various phases of this investigation. Seeds of a number of plant species obtained were either dormant or nonviable and accordingly failed to germinate in innumerable trials. Detailed information relative to certain phases of this study are included either in a manuscript or in two master's theses which accompany this report. (Auth)

<213>

Comar, C.L., R.S. Russell, and R.H. Wasserman, Strontium-Calcium Movement from Soil to Man. 1957. Science, 126, 485-492

The pathway of strontium from soil to man is discussed. The expression 'observed ratio' is defined and applied to several physiological processes. (CWF)

<214>

Corey, J.C., Contribution of Tritiated Water at Various Depths in Soil to Evaporation at the Soil Surface. 1968, January 10. DF-HS-67-95; CONF-680108-10: Part of Proceedings of a Symposium on Environmental Surveillance in the Vicinity of Nuclear Facilities held in Augusta, Georgia, January 24-26, 1968, (p. 1-24) (Savannah River Laboratory, Aiken, SC)

Tritiated water deposited on the soil returns directly to the atmosphere by evaporation from the soil surface and by transpiration by plants. The time for tritiated water to evaporate from a loamy sand was measured when tritiated water was placed 0 to 14, 14 to 28, or 28 to 42 cm below the surface and for soil water contents of 0.05 and 0.10 g/g of oven-dry soil. The evaporation time increased with the depth of placement and with a decrease in water content. Tritiated water 14 to 28 cm below the soil surface did not evaporate before 60 hr. Tritiated water 28 to 42 cm below the soil did not evaporate before 200 hr from soil wet to 0.10 g/g of oven-dry soil, and not before 300 hr from soil wet to 0.05 g/g of oven-dry soil. (Auth)

<215>

Corey, J.C., D.R. Nielson, J.C. Picken, Jr., and D. Kirkham, Miscible Displacement through Gamma Radiation-Sterilized Soil Columns. 1967. Environ. Sci. Technol., 1, 144-147 (Iowa State University, Ames, IA)

Gamma radiation from a Co 60 source has proved successful in sterilizing soil columns. Sterile miscible displacement methods were used to follow the displacement of nitrate at slow velocities through soils. After a soil column was sterilized, 100 percent of the nitrate added to a Webster soil-sand column was recovered in the effluent after displacement at 0.055 cm per hour, while 66 percent of the nitrate was recovered when displaced through a nonsterile column at the same velocity. (Auth)

<216>

Corey, J.C., S.P. Peterson, and M.A. Wakat, Measurement of Attenuation of Cesium 137 and Americium 241 Gamma Rays for Soil Density and Water Content Determinations. 1971. Soil Science Society of America Proceedings, 35, 215-219 (Savannah River Laboratory, Aiken, SC)

Soil density and water content can be determined concurrently by measuring the attenuation of two different gamma energies. A dual source containing Am 241 and Cs 137 was shown to be suitable for these measurements. Multichannel pulse-height analyzers were evaluated to determine their accuracy under experimental conditions for simultaneous measurements of soil density and water content. NaI(Tl) and Ge(Li) detectors were also evaluated. The measurements were made with a collimated beam, 1 cm in diameter, of 662-keV gamma rays from a source containing mCi 70 of Cs 137 and mCi 29 of Am 241. Measured mass attenuation coefficients were 0.08565, 0.07803, and 0.07887 cm²/g for cesium gamma rays and 0.20493, 0.27100, and 0.33480 cm²/g for americium gamma rays with water, Cecil, and Houston Black soil, respectively. The higher resolution of the Ge(Li) detector and a 4096-channel pulse-height analyzer had no significant advantage with peaks as widely separated as 662 keV. A NaI(Tl) detector and a 400-channel pulse-height analyzer were satisfactory. With the multi-channel pulse-height analyzer, it was simpler to adjust the area under the americium peak for the Compton contribution from the cesium radiation than with a single channel pulse-height analyzer. Water content and density changes in both a swelling and nonswelling soil illustrate the utility of the system. (Auth)

<217>

Costa, F., I. Esparraguera, M. Ortin, M. Del Val, P. De la Cruz, O. Carpena, and R.F. Cellini, Influence of Irrigation Rate and Soil Type on the Vertical Migration of Iron and Manganese in the Soils of Southeast Spain. 1967. CONF-670641; STI/PUB-158; Symposium on the Use of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies, Istanbul, (p. 251-268) (Junta de Energia Nuclear, Madrid, Spain)

The citrus plantations in southeast Spain, situated largely on calcareous soils which are submitted to intensive cultivation, are investigating nutritional changes caused mainly by deficiencies of trace elements, especially iron and manganese, which result in a lower yield and premature exhaustion of the trees. A radioactive tracer study was made of the behavior of these ions in soils and the factors influencing their migration to the root zone; the object of the work is to develop a rational and economic fertilization policy. The work has been based on two types of soil, representing extreme situations encountered in practice: one soil is calcareous and the other non-calcareous. A set of columns was assembled, each column having a length of 1 m and a cross-section of 32 cm²; solutions of Fe 59 and Mn 54 were added to these columns both in sulphate and chelate form. A definite amount of water, proportional to the requirements of citrus plantations, was intermittently passed through these columns. Soil samples were taken periodically and the total activity and the activity of the assimilable and non-assimilable fractions of the elements being studied were measured. At the same time an apparatus involving a collimated scintillation detector was developed to follow the vertical migration of these ions in soils;

<217> CONT.

the water drained from the columns after each irrigation was analyzed radiochemically for the same purpose. (Auth)

<218>

Courtois, G., Sediment Dynamics and Radioactive Tracers - Status of Work in France. 1970. ORNL-tr-2492; Houille Blanche, 25, 617-628

The development and current status of radioactive tracer techniques for studying sediment dynamics are discussed with particular reference to current French experimental work for determining the possibilities of using tracers for measuring the movement of sands and muds, soil erosion, and mass stability, and for studying any problem of particle movement. (NSA)

<219>

Cowser, K.E., Movement of Ruthenium in the ORNL Waste-Pit System. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

A significant increase in the amount and concentration of fission products released to the ORNL waste-pit system occurred in 1959. The concentration of ruthenium in the chemical waste entering Pit 3 during September 1959 averaged about $2 \times 10^{(E+8)}$ d/m/ml or 90 uCi/ml; the average for the year was 14.5 uCi/ml. Based upon assumed conditions and evaluation of past events, it is estimated that 24,000 curies of Ru 106 may be released to the Clinch River each year without exceeding the calculated MPC value (continuous nonoccupational exposure) for the river. With the waste-pit system acting as the primary source of Ru 106 discharged to the river on an annual basis, it is estimated that the concentration of Ru 106 in waste released to the pit system should not exceed 25 uCi/ml, this would amount to 350,000 curies of Ru 106 in 3.7 million gal of waste each year. Special treatment of the waste to enhance the removal of Ru 106 was not considered in the calculations. No attempt has been made to establish an allowable concentration of Ru 106 in waste released to the pits. Such a value is influenced by laboratory policy regarding use of the natural environment for waste disposal, riparian rights for equitable use of the river, federal and/or state regulations, and ultimately the effects of such release in the physical, chemical, and biological systems of the river. (Auth)

<220>

Craker, L.E., Accumulation and Distribution of Strontium Within Tissues of a Wheat Spike. 1967. Ph.D. Thesis; 85 p. (University of Minnesota, Minneapolis, MN)

Studies on strontium accumulation in grain of excised wheat spikes from nutrient solution containing strontium indicated genotypic differences in processes governing strontium accumulation in the grain between Red Bobs and Kenya 117A. To determine the nature of the physiological process (i.e., active or passive) governing strontium accumulation in grain, the relationship of physical and metabolic mechanisms to strontium accumulation in grain was studied. Physical processes would be implicated if strontium accumulation in the grain could be correlated with such factors as the vascular anatomy of the wheat

spike or difference in transpiration rates of wheat kernels. Metabolic processes would be implicated if strontium accumulation in grain could be related to energy dependent processes. Preliminary studies were conducted to determine the effect of strontium concentration of the ambient solution, plant maturity, hydrogen ion concentration, associated inorganic ions, and absorption time on strontium accumulation in the physiological processes involved in strontium accumulation in the grain. No consistent difference between Red Bobs and Kenya 117A was detected in physical factors of size or number of xylem elements connecting the rachis to the grain. Furthermore, no relationship between transpiration rate and rate of strontium accumulation in grain was observed in either variety. From these results, it was concluded that processes other than passive movement with the transpiration stream were functioning in strontium accumulation in the grain. The association between strontium accumulation in the grain and metabolic processes was indicated by the marked effects of sodium azide and dinitrophenol on strontium accumulation. Strontium accumulation in the grain of excised spikes was significantly inhibited in both varieties 10 and 20 days after anthesis at sodium azide and dinitrophenol concentrations of $1 \times 10^{(E-3)}$ M. These results led to the conclusion that strontium accumulation in grain was related to processes dependent upon metabolic energy derived from respiration. (Auth)

<221>

Craker, L.E., and L.H. Smith, Mechanisms of Strontium Accumulation in Tissues of Wheat Spikes. 1969. Crisp Science, 9, 564-567 (University of Minnesota, St. Paul, MN)

Studies of strontium accumulation in grain of excised wheat spikes indicate that active mechanisms, analogous to those based upon the carrier concept in root absorption studies, mediate this process. No evidence was found to suggest that Sr is passively accumulated in grain. No relationship between transpiration rate and Sr accumulation in grain was found. (Auth)

<222>

Creger, C.R., and W.S. Allen, Strontium Mobility in Germinating Seeds and Plants. 1969. Plant Physiology, 44, 439-441 (Texas A&M University, Department of Biochemistry and Biophysics, College Station, TX)

The uptake of strontium in the bean plant was linear for the first 34 hours during continuous exposure to radiostrontium. After 35 hr there was a sharp increase in the rate of uptake to 48 hrs. Radioactivity could be detected in the plant as early as 1 hour after addition of radiostrontium to the growth medium. The radioactivity in the developing third and fourth leaves of cotton plants increased at the expense of the radioactivity in the first 2 leaves and stems. This represents a movement into certain parts and then a retranslocation out of these parts as other tissue begins to develop. (Auth) (CWF)

<223>

Creger, C.R., E.C. Holt, and D.A. Lovelace, Calcium and Strontium Relationship in Various Commercially Important Plants. 1970. Agronomy Journal, 62, 297-299 (Texas A&M University, Agriculture Experiment Station, College Station, TX)

<223> CONT.

The rate of uptake and the degree of translocation of strontium was investigated, as well as the amounts taken up and the effects on the growth of sorghum, cotton, and bean plants when high levels of strontium are incorporated into the culture medium. (Auth) (CWF)

<224>

Cromov, H.L., W.A. Goldsmith, C.R. Phillips, and W.P. Bonner, Uptake of Cesium 137 from Contaminated Soil by Selected Grass Crops. 1967. Radiological Health Data and Reports, 8, 421-424 (University of Florida, Department of Radiology and Bioenvironmental Engineering, Gainesville, FL)

The cesium 137 content of milk in the Tampa, Florida area has been consistently above the national average in recent years. The possibility that grasses grown in this area receive their contamination indirectly through contaminated soil is being investigated. Among the grasses investigated the uptake of cesium 137 appears to be greatest for pangola grass. (Auth)

<225>

Crozier, W.D., Direct Measurement of Radon 220 (Thoron) Exhalation from the Ground. 1969, August 15. J. Geophys. Res., 74, 4199-4205 (New Mexico Institute of Mining and Technology, Socorro, NM)

A method has been devised for direct measurement of the Rn 220 flux through the ground surface ("exhalation"), and measurements are reported for six sites. At one site comparisons are made between the measured exhalation and those exhalations deduced from Rn 220 profiles in the air above the site; agreement is good with low intensity of turbulence. The discrepancies with higher turbulence are discussed. (Auth)

<226>

Csallany, S.C., Application of Isotope Techniques in Groundwater Hydrology. 1967. Part of Marino, M.A. (Ed.) Proceedings of the Symposium on Groundwater Hydrology, San Francisco, California, (p. 351-357) (Illinois State Water Survey, Urbana, IL)

A summary is presented of some current and possible future uses of radioisotopes in ground water research. The most commonly used radioisotopes and the methods in which they are used are tabulated. (NSA)

<227>

Csupka, S., Cesium 137 in the System of Soil-Plant in the Years 1964-1969. 1971. Pol'nohospodarstvo, 17, 363-370 (Oblastna Hygienicka Stanica, Bratislava, Czechoslovakia)

In the course of the years 1964-1969, radiocesium in soils and lucerne was followed under natural conditions. A certain correlation was found between potassium, calcium, and phosphorus in soil and in lucerne as well as between the exchangeable potassium and radiocesium in soil. The relationship between the content of Cs 137 in soils and in lucerne is expressed by a positive correlation ($r = +0.47$). There occurred accumulation of radiocesium in soil under the influence of the fallout. The extent to which the soil component will be present in the contamination of plants will depend especially on meteorological and soil conditions and whether radiocesium gets outside the root system of

plants. (Auth)

<228>

Csupka, S., Soil Solution and Its Influence on the Uptake of Strontium 90 and Calcium by Alfalfa. 1970. CONF-690918-(Vol. 2); Part of Proceedings of an International Symposium on Radiocology held in Cadarache, France, September 8-12, 1969, (p. 883-893), 506 p. (Regional Station of Hygiene, Bratislava, Czechoslovakia)

A study was made of 2 types of soil with different exchangeable Ca content. The Ca and Sr 90 concentrations in the extracts obtained by extraction with deionized water, 1 M ammonium acetate and 6 M hydrochloric acid were determined. This gradual extraction gives an idea of the mobility and migration of ions in soil solutions and shows that the selection of Sr 90 from the soil is dependent on the Ca exchangeable content of the soil. The Sr 90 and Ca absorption by alfalfa was measured and the discrimination factors were calculated. The influence of rainfalls and radioactive fallouts on the Sr 90 content of the soil and alfalfa is discussed. (Auth)

<229>

Csupka, S., M. Petrasova, and J. Carach, Strontium 90 Activity in Grass and Alfalfa During 1962 and 1963 in West Slovakia. 1965. Atompraxis, 11, 386-389 (Hygienisch-Epidemiologisches Institut, Bratislava, Czechoslovakia)

The 90 Sr content of grass and alfalfa was studied during the vegetation months in four separate regions of West Slovakia. With the aid of soil analyses, the soil-plant discrimination factors were ascertained, and the influence of the calcium content of the plants and soil on the extent of the Ca to Sr 90 ratio was determined. (Auth)

<230>

Csupka, S., M. Petrasova, and J. Carach, Seasonal Variation in the Concentration of Cesium 137 in Grass and Alfalfa. 1967. Nature, 213, 1204-1206 (Regional Station of Hygiene and Epidemiology, Bratislava, Czechoslovakia)

Analyses of the content of cesium 137 and other radionuclides in grass and alfalfa in Western Slovakia during 1962-1965 indicate that such measurements provide a means of determining the rate of radioactive fallout from nuclear weapon tests, provided certain climatic factors are taken into consideration. (Auth)

<231>

Cullen, T.L., A Study of Natural Radioactivity in Brazil. 1967. NYC-2577-8; 68 p. (Pontificia Universidade Catolica, Do Rio De Janeiro, Instituto De Fisica, Brazil)

Results of studies of natural background radiation in monazite areas; radon 220 in the atmosphere; thoron body burden; thorium activity in the atmosphere and a lamp factory; thorium detection and measurement in lamp factory personnel; gamma ray activity in squars; and radiochemical assay of Pb 210, Ra 228, and Th 228 in plants in Brazil are reported. Instruments used were thermoluminescent dosimeters, scintillation flasks, whole body counters, and Casella cascade impactors. (ST)

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Cullen, T.L., I.M. Antunes, and A. Chabot, A

<232> CONT.

Study of Natural Radioactivity in Brazil. 1970. NYO-2577-12; 30p. (Pontificia Universidade Catolica, Rio de Janeiro, Brazil)

This is one of the progress reports on the effect of high natural radioactivity found in several locations in Brazil on human and plant populations. The studies have been carried out by the Institute of Biophysics, Federal University of Rio de Janeiro. (CWF)

<233>

Cummings, S.L., and L. Bankert, The Uptake of Cerium 144, Promethium 147, and Plutonium 239 by Oat Plants from Soils. 1971. Radiological Health Data and Reports, 12, 83-85 (Environmental Protection Agency, Radiation Office, Southeastern Radiological Health Laboratory, Montgomery, AL)

The uptakes of cerium 144, promethium 147, and plutonium 238 by oat plants were determined for nine soils, and promethium 147 and plutonium 238 uptakes were compared with cerium 144 uptake. The percentage uptakes values for all three radionuclides were very low, ranging from 10(E-6) to 10(E-3) percent. Nitrogen and potassium fertilizers increased the uptake of promethium 147 by oat plants from an Amite soil. Because the amount of cerium 144, promethium 147, and plutonium 238 taken up by plants from soils is very small, the health hazards to man by the soil-plant-man pathway from these radionuclides will probably be negligible at the levels used in this study. (Auth)

<234>

Cummings, S.L., L. Bankert, A.R. Garrett, Jr., and J.E. Requier, Cesium 137 Uptake by Oat Plants as Related to the Soil Fixing Capacity. 1969. Health Physics, 17, 145-148 (Southeastern Radiological Health Laboratory, National Center for Radiological Health, Montgomery, AL)

Soils can retain Cs 137 in a fixed state which is relatively unavailable for plant absorption. This ability is largely attributed to vermiculite or related minerals capable of forming a relatively stable collapsed structure when saturated with Cs(+), Rb(+), K(+), or NH₄(+) ions. Soils are quite variable in their capacity for fixing cesium. A significant correlation was obtained between the oat uptake of Cs 137 and the soil fixing capacity. Oat uptake decreased as the soil fixing capacity increased. The results suggest that the low fixing capacity of the Florida soils is an important factor giving rise to the higher than average Cs 137 concentrations in the milk of Tampa, Florida, area. (Auth)

<235>

D'eri, D., and N.G. Zyrin, Characteristics of Dynamics of Manganese, Cobalt, Copper, Zinc and Molybdenum in the Soil-Plant System. 1965. Akrokhimiya, 2, 87-97 (Moskov Gosudar. University, Moscow, USSR)

The most important agricultural soils in Hungary and derno-podzolic soils in the Moscow region were studied. Mn, Cu and Zn accumulate in the humus horizons of chernozems. Mo tends to accumulate here biologically too, but Co does not. In derno-podzolic and brown forest soils, Mn accumulates in the humus horizon. In all horizons of all soils, Cu, Zn and Mo accumulate in the clay fraction but Mn and Co, particularly in illuvial horizons do not always accumulate therein. The concentrations of mobile trace elements are usually highest

in the upper soil horizons, but the concentrations of mobile Zn and Cu in derno-podzolic and brown forest soils are sometimes higher in the A2 or B horizons. The concentrations of trace elements in wheat at the shooting stage are correlated with their mobility in the various soils, but later on this correlation disappears. Removal of Mn by the crop is correlated with mobility, but removal of Zn, Cu, Mo and Co is not correlated with their respective mobilities. Wheat grain & straw removed 200-400 q/ha Mn, 110-170 q Zn, 12-27 q Cu, 2-6 q Mo and 0.1-0.2 q Co. (Soils and Fertilizers)

<236>

D'Souza, T.J., R. Kirchmann, and J.J. Lehr, Distribution of Radiostrontium and Radiocesium in the Organic and Mineral Fractions of Pasture Soils and Their Subsequent Transfer to Grasses. 1971. CONF-711213; IAEA/SM-151/4; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971, (p. 1-18) (Centre d'Etude de l'Energie Nucleaire, Department of Radiochemistry, Mol, Belgium)

Plant uptake studies with radiostrontium in Belgium permanent pastures indicated that the dominant factors controlling the distribution of strontium 85 deposited as a foliar application to the "mat" and in the "soil" was the clay and organic matter contents. (CWF)

<237>

D'Souza, T.J., and K.B. Mistry, Comparative Uptake of Thorium 230, Radium 226, Lead 210, and Polonium 210 by Plants. 1970, June. Radiation Botany, 10, 293-296 (Bhabha Atomic Research Centre, Bombay, India)

Quantitative data are reported on the entry and translocation of Th 230, Ra 226, Pb 210, and Po 210 measured under closely comparable conditions in nutrient culture experiments; Sr 89 was included for comparison. It is shown that the accumulation of Th 230, Pb 210, and Po 210 occurs predominantly in the roots and only very small amounts of these nuclides are translocated to shoots. Over comparable periods, the accumulation of Ra 226 in roots is 2 to 3 times lower than that of other nuclides of the uranium series. The most significant difference between Ra 226 and other nuclides is that the upward transport for radium is 50 to 200 times greater and the amount of radium translocated to shoots is comparable to that of strontium. (Auth)

<238>

D'Souza, T.J., and K.B. Mistry, Preliminary Studies of the Absorption and Translocation of Polonium 210-Lead 210 in Plants. CONF-660341; Part of Proceedings of the All India Symposium on Radioactivity and Meteorology of Radionuclides held in Bombay, India, March 14-18, 1966, (p. 381-401) (Atomic Energy Establishment, Trombay, India)

The accumulation of Pb 210, Po 210, and Sr 89 by PHASEOLUS VULGARIS L plants over a seven day treatment period in cultured solution was examined. Both Pb and Po accumulated mostly in the roots, and only very small amounts were translocated to the shoots. Sr was transported up the plant in relatively large amounts. On a total plant basis, the percent uptake of Pb and Po was greater than that for Sr. The values for percent uptake and accumulation factors for Pb were higher than those of Po by an order of magnitude. While massive

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accumulation of Pb and Po occurred in the roots, significantly higher concentrations were present in the stem as compared with the leaves. Strontium accumulation factors for stems and leaves were higher and those for roots were lower than the corresponding Pb and Po accumulation factors. The effects of salt concentration of the culture solution, citrate ions, 2,3-dinitrophenol, and deionized water on the accumulation and retention of these radioisotopes were investigated. (NSA)

<239>

Dahlman, R.C., and S.I. Auerbach, Preliminary Estimation of Erosion and Radiocesium Redistribution in a Fescue Meadow. 1968, November. ORNL-TM-2343; 24 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

The potential radioactivity redistribution was evaluated for observed and hypothetical conditions of precipitation prior to application of a fallout simulant to fescue vegetation. Estimates from this analysis were compared with those of the radionuclide movement experiment from Area 0807 and also compared with predictions of erosion using the Wischmeier and Smith soil-loss equation. Based on observed erosion loss as a function of different precipitation events, approximately 0.06 percent of the Cs 137 contaminant will move from each contaminated area annually, and the input to the natural drainage system will be less than 2 μ Ci from 4-100 \pm 2 plots. This estimate is one-fortieth of other independent predictions and measurements because the dense fescue vegetation and sod of the simulant-plots greatly reduce erosion and mineral element loss in runoff. (Auth)

<240>

Dahlman, R.C., S.I. Auerbach, and P.B. Dunaway, Behavior of Cesium 137-Tagged Particles in a Fescue Meadow. 1969. STI-PUB-226; CONF-690317; Part of a Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials held in Vienna, Austria, (p. 153-165) (Oak Ridge National Laboratory, Oak Ridge, TN)

Enclosures of tall fescue (PESTUCA ARUNDINACEA), 0.01 hectare in area, were contaminated at the rate of 25 μ Ci/sq ft using artificial fallout (Cs 137 fused to 88 to 177 micrometer silica sand, approximately 100 microcuries/g, 15% leachable in water) to study the effects of close-in fallout on a grass system. Investigations of radiation effects, intercompartmental cycling of radiocesium and secondary movements of the simulant particles in soil and litter have been in progress since mid-summer, 1968. Plant community response (yield, seed production, and species composition), small mammal physiology (hemopoietic and gut effects) and insect population dynamics are being studied following exposure to chronic, internal-external, beta-gamma radiation. Sand particles intercepted by grass blades were readily dislodged by light wind, and maximum retention time was approximately 10 days. The simulant was readily trapped in the leaf axils where it remained for 4 weeks until washed off by rain. There was significant transfer (15%) of Cs 137 from simulant to vegetation. Vacuum and brush-cleaned vegetation initially contained 1.32 microcuries/g (living parts) and 4.62 microcuries/g (dead parts). Early incorporation into foliage was largely by contact assimilation because appreciable uptake had occurred before the simulant had

reached the soil. Two loss rates were evident in the subsequent decrease of Cs 137 in living foliage. The fast component, which began 8 days after contamination and continued for 4 weeks, was described by the linear regression $Y=1.64-0.04X$ where Y and X are microcuries Cs 137/g foliage and days, respectively. The slower loss rate commenced 4 weeks after contamination and its regression was $Y=0.61-0.003X$. Only 0.12 microcuries of Cs 137 (0.006% of that present) was carried from the tagged areas in one runoff event. This agreed remarkably well with that predicted from a simple model based on characteristics of simulant and soil and on rainfall-runoff relations. (Auth)

<241>

Dall'Aglio, M., Study of the Circulation of Uranium in the Supergene Environment in the Italian Alpine Range. 1971, January. Geochim. Cosmochim. Acta, 35, 47-59 (Comitato Nazionale per l'Energia Nucleare, Rome, Italy)

Geochemical prospecting surveys for uranium, carried out in the metamorphic basement of the Italian Alpine Range, detected marked anomalies both in alluvia and waters in the Martello Valley (Trentino Region, Northern Italy). Detailed surveys showed that no uranium occurrences or deposits outcrop in the vicinity of the geochemical anomalies. A detailed study was therefore made in order to determine the causes of these anomalies. Analyses of uranium were made on fresh water, rock, stream sediment and soil samples. The water samples were also analyzed for all the major as well as for some trace elements. Leaching tests on rock samples provided additional information with a view to understanding better the dissolution of uranium with respect to the major elements. The results of these studies emphasize some characteristics of uranium in the supergene environment. Uranium, particularly that contained as uraninite in the pegmatites, is the element which passes most readily into the natural waters, where it may reach anomalous values, even starting from rocks with a normal content. Part of the uranium dissolved in fresh waters is precipitated by the organic matter of soils and stream sediments. The percentage of the uranium precipitated is not high, but it is sufficient to raise the uranium content of the alluvia to significant anomalous values. These processes, in the particular environment of the explored region, explain the anomalous values found in waters and alluvia, starting from rocks whose uranium contents average slightly more than the Clarke value (approximately 5 ppb). (Auth)

<242>

Darab, K., and I. Torok, Factors Influencing the Movement and Fixation of Strontium 90 in the Soil. 1971. Agrochim. Talaian, 20, 147-154 (National Institute of Agricultural Quality Testing, Budapest, Hungary)

The Sr 90 contamination of 11 soils of different types and textures was studied. The soils examined were huson sand, meadow soil and different types of salt affected soils having textures varying widely from silty sand to heavy clay. The total Ca content in the soils and in their colloid fractions were also different. In the salt affected soils there were differences in the total salt contents, ESP values and the soluble salt compositions. The areas represented by the samples examined were partly under grassland partly under agricultural cultivation. One sample was taken from a rice field. The Sr 90 was

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determined by the oxalate method, after extraction with hydrochloric acid; the activities are given in $\mu\text{Ci}/\text{kg}$. According to the results it can be stated that in salt affected soils the fixation and mobility of Sr 90 depends on the alkalinity, on the relative amount of exchangeable Na ions (ESP) and the quantity and chemical composition of the soluble salts. The higher alkalinity of the soils' liquid phase, the lower solubility and mobility of the Ca compounds in the soil, the more intense accumulation of Sr 90 in the uppermost soil layers and higher Sr-fixation. Due to the particular water regime and chemical properties of the salt affected soils, the texture has only a second-hand role in the degree and form of strontium fixation which are influenced first by the degree of salinity and alkalinity. In non-cultivated soils, the radioactive contamination occurs mainly in the thick top layer. As a result of mechanical mixing, the Sr 90 contamination of arable lands is uniformly distributed in the ploughed layer. By the reclamation of salt affected soils, the radioactive contamination of the top layer can be reduced and the leaching of fission products can be promoted by increasing the solubility of Ca compounds in the soil and, at the same time, the concentration of $\text{Ca}(2+)$ ions in the soil solution. When CaCO_3 and CaSO_4 are not present in considerable amounts in the soil, the mobility of Sr 90 can be increased by the application of calcium containing chemical amendments. Beside increasing the $\text{Ca}(2+)$ ion concentration in the soil solution, the possibilities of a better downward water movement and leaching is also to be promoted by eventual irrigation. (tr-Auth)

<243>

Dauskurdis, S.I., and Yu.V. Novikov, Hygienic Problems of Strontium 90 and Cesium 137 Migration Along the Chain Soil-Plants-Milk and Beef. 1973. Gig. Sanit., 4, 91-94 (Not given)

The uptake of Sr 90 by fodder plants from the soil was determined in relation to the type and pH of soil, type of fodder (hay, straw, and grass), and the quantity of Sr 90 found in each type of fodder. Average Sr 90 and Cs 137 contents in beef and milk are shown graphically for the years 1965 through 1969 and discussed. (NSA)

<244>

Davidescu, D., G. Pavlovschi, and V. Davidescu, Uranium in Vine and Wine. 1969. Rev. Hort. Viticult., 18, 93-100 (Not given)

In the soils of the Velea Calugareasca and the Draqasani vineyards, mobile uranium ranges between 14 and 163 $\mu\text{g}/\text{g}$ of soil. The distribution of uranium in various vine organs is not a simple process of suffusion. Higher accumulations are found in the stones. The variable uranium uptake into the different vine species affects this mineral content in wines. The maximum concentration was found in the Royal Petesca (Maidenly) of the Valea Calugareasca (300 $\mu\text{g}/\text{g}$ or 1000 $\mu\text{g}/\text{g}$). (NSA)

<245>

Davis, S.W., Discussion of Paper by Walter E. Reed, Transport of Water Away from a Buried Heat Source with Special Reference to Hydrologic Phenomena Observed at Aardvark Nuclear Detonation. 1971, January. J. Geophys. Res., 76, 630-634 (University of Missouri, Columbia, MO)

A possible explanation of the abnormally high

water level in a well near the Aardvark detonation, a Nevada Test Site underground nuclear test in tuff, is presented. It suggests that, contrary to the theses of other investigators, mechanical compaction of the saturated and porous zones near the explosion was the most important factor causing the well water level to rise. (NSA)

<246>

Dayton, B.R., Accumulation and Transfer of Radiostrontium by Young Loblolly Pines. 1968; 1970. Ph.D. Thesis; Ecology, 51, 204-216 (University of North Carolina, Chapel Hill, NC)

A study was conducted to quantify transfer and accumulation of radiostrontium by young loblolly pines on the Savannah River Plant, South Carolina. Stems of seven trees were each inoculated with 3 μCi of radiostrontium. Accumulation of radiostrontium in foliage continued for 13 months after inoculation, when a maximum of 1265 μCi per tree was attained. The prolonged period of accumulation in foliage was attributed to the influence of ion exchange on translocation and to the long life span of needles. The pattern of uptake and distribution in tree crowns was similar to that reported by other investigators for stable calcium in loblolly pines. There was little evidence of basipetal translocation of radiostrontium to roots. About 2% of the maximum foliage burden of radiostrontium was released by leaching during the 16 months of the study. Radioactivity of rainwater falling through crowns was best correlated with needle radioactivity, but was also inversely correlated with intensity of precipitation. Transfer of leached radiostrontium to the ground by rainwater flowing down stems was only 23% of that transferred by rainwater falling through tree crowns. Twenty percent of the maximum foliar uptake was released by needles falling from the trees. Most of this release occurred in the summer and autumn of 1967 when needles that were accumulating strontium since 1966 fell from the trees. The inoculated pines accumulated three times more radiostrontium in foliage than they released by needle fall and leaching. At the conclusion of the study, radiostrontium was distributed in the ecosystem in the following manner: 51% in stems and branches, 38% in needles, 10% in litter, and less than 1% in soil, roots, and understory. Ninety-four percent of the radiostrontium released from the inoculated trees was in litter. In 16 months only 4.6% of total radiostrontium released from foliage was transferred to mineral soil. Ground cover under the inoculated trees, primarily the litter, accumulated 20 times more radiostrontium than it released. Although much of the radiostrontium transferred to soil was confined to the top 2.5 cm where feeder roots are most abundant, less than 10% of the radionuclide accumulated in soil was in roots. Accumulation in soil and roots closely approximated input from needle fall and foliar leaching, indicating that release from roots of basipetally translocated radiostrontium was negligible. Little or no transfer out of the system by leaching to subsoil, runoff, or blowing away of litter was detected. In young pine stands, the increasing amount of litter added each year and the slow release to mineral soil would lead to a rapid accumulation of radiostrontium in litter and underlying organic matter. The radiostrontium burden of a pine forest contaminated by a pulse of radioactive fallout might be reduced considerably by removal of litter after peak needle fall. (Auth)

<247>
De Bortoli, M.C., Methods of Analysis for Soil Radioactivity. 1968. HASL-197; Part of Hardy, E.P., Jr., and Rivera, J. (Eds.), Fallout Program, Quarterly Summary Report, March 1-June 1, 1968, (p. I.233-I.240) (Euratom, Protection Service, Ispra, Italy)

Some analytical procedures used at the Protection Service of the Euratom Establishment for the surveillance of soil radioactivity are described. (CWF)

<248>
De Bortoli, M.C., Methods for Analysis of the Radioactivity in the Soil. 1969, January-March. Minerva Fisiconucl., 13, 86-92 (Euratom-CCR, Ispra, Italy)

Some of the analytical methods used at the Protection Service of the Euratom Ispra Establishment for the surveillance of soil radioactivity are described. The radioisotopes of strontium, cesium, and plutonium can be determined on a single soil aliquot by appropriate chemical procedures. Measurements of the uranium concentration are performed through a fluorimetric technique. Some comments, deriving from the experience gained through the routine exploitation of the methods described, are reported. (Auth)

<249>
De Bortoli, M.C., and P. Gaqlione, Natural and Fallout Radioactivity in the Soil. 1969. Health Physics, 17, 701-710 (Euratom Joint Research Centre, Ispra, Italy)

The long-lived radionuclides (Sr 90, Cs 137, and Pu 239) from weapon fallout were measured in soil samples collected in the surroundings of the Euratom Ispra Establishment (Northern Italy). The vertical profile of the contamination and the distribution of Cs 137 in soil particles of different size were studied. In addition, also the concentration of natural radionuclides was determined and the calculated air dose-rate has been compared with that measured by means of a portable ionization chamber. (Auth)

<250>
De Bortoli, M.C., P. Gaqlione, and A. Malvicini, Some Data and Comments on Sodium 22 in Food Chains. 1966. Health Physics, 12, 353-359 (Euratom Joint Nuclear Research Center, Ispra, Italy)

Measurements of Na 22 concentration in fallout, herbage and milk samples are described together with the method employed, which consists of gamma spectrometry in coincidence with the sum pulses of the gamma rays in cascade. (Auth) (CWF)

<251>
De Datta, S.K., R.E. Franklin, and F.L. Himes, Partial Characterization of Soil Polysaccharide Strontium 90-Yttrium 90 Complexes. 1967. Soil Science, 103, 47-54 (Ohio State University, Columbus, OH)

Chromatographic techniques were used to fractionate certain polysaccharide complexes reacting with strontium and yttrium in hot water soil extracts. (CWF)

<252>
De Laguna, W., K.E. Cowser, and F.L. Parker, Disposal of High-Level Radioactive Liquid Gases

in Terrestrial Pits: A Sequel. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 101-115), 624 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

The movement of radionuclides from terrestrial pits used to dispose of high-level wastes is examined. (CWF)

<253>
De Saint-Blanquat, H., The Fate of Carbon 14. 1968. Sci. Avenir, 255, 408-415

Numerous errors which have now been demonstrated have caused the reconsideration of C 14 as a tool for archeological dating, though it has succeeded in many unexpected tests. Irregular absorption of C 14 by trees has been demonstrated by dendrochronology; tests made with SEQUOIA GIGANTEA show deviations only rarely exceeding 2% up to 3000 yr, but beyond that age much too great an age is read by C 14 methods. The problem of the cause of the variation in the C 14 level in the atmosphere over the epochs is noted. A deviation of 800 yr is found at objects dated 4000 B.C. by dating with PINUS ARISTATA; other methods allow dating to 11,000 B.C. for comparison. At 6500 B.C. good correlation with C 14 dating is again found. Before this date a deviation of C 14 dating in the opposite direction (C 14 age too old) is found. The study of paleoclimatic conditions is described with C 14 studies of corals. Effects of nuclear weapons testing on C 14 levels are noted with respect to dating procedures. (NSA)

<254>
Deak, M., E.D. Kiseleva, T.D. Semenovskaya, and K.V. Chmutov, The Sorption of Calcium and Strontium Ions by Titanium and Zirconium Hydroxides. 1971. Russian Journal of Physical Chemistry, 45, 989-990 (Institute of Physical Chemistry, Academy of Sciences, Moscow, USSR)

The use of buffer mixtures promotes an increase in the degree of dissociation of the exchanging groups of hydroxide sorbents and in their sorption capacity. At pH 11 the amounts of calcium sorbed on titanium and zirconium hydroxides are respectively 6.0 and 3.7 mequiv/g(-1) (t=20 degrees C). (Auth)

<255>
Delmas, J., A. Grauby, and R. Disdier, Transfer of Radionuclides to Plants by Irrigation. 1970. Bull. Inform. Sci. Tech, 151, 67-73 (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Cadarache, France)

In order to study the contamination of plants by irrigation, an experimental model simulating the radioccontamination of cultures by sprinkling them with water was developed. The absorption and distribution of radioelements in these plants were studied, and the ratio between the contamination of the food and the water determined. The relative importance of direct and indirect contamination of various plants was determined using Cs 137 and Sr 90. (Auth)

<256>
Deshpande, K.B., and C.E. Marshall, An Interpretation of Electrochemical Measurements on a Montmorillonite Clay. 1959. Journal of Physical Chemistry, 63, 1659-1662 (University of Missouri, Department of Soils, Columbia, MO)

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<256> CONT.

Changes in (1) conductivity, (2) pH, (3) cation activity, (4) migration velocity of clay particles and (5) cation-halide ion pair activities during the titration of an acid-montmorillonite clay were studied. (Auth) (CWF)

<257>

Deshpande, K.B., and C.E. Marshall, Comparisons of Electrometric Measurements in Clay Systems. 1961. Journal of Physical Chemistry, 65, 33-36 (University of Missouri, Department of Soils, Columbia, MO)

Measurements of salt activity, cation activity and low and high frequency conductance have been made on potassium and calcium montmorillonite clay systems, using several additions of halide salts and several degrees of saturation of the clay with the cation. (Auth) (CWF)

<258>

Dev. G., Experiments on Plant Uptake of Radiostrontium from Contaminated Soils. Effect of Phosphate Fertilization. 1965. Meldinger fra Norges Landbruksforskole, 44, 1-7 (Agricultural College of Norway, Isotope Laboratory and State Soil Investigation, Vollebekk, Norway)

A greenhouse study was carried out to determine the effect of phosphorus fertilization on the uptake of radiostrontium from three acidic soils. Phosphorus application at the rates used were shown not to affect the uptake of radiostrontium in tomato plants. (CWF)

<259>

Dibobes, I.K., S.Y. Zaidman, L.I. Pantaleev, and A.M. Skryabin, Mechanisms of Strontium 90 Behavior in Food Chains Following Atmospheric Deposition. 1969, January. Gig. Sanit., 1, 41-44

Investigation of the Sr 90 contamination of plants by global fallout led to the discovery that the rate of aerial contamination of plants was 20 to 200 times higher than the rate of plant contamination from soil containing the same density of contaminant. This situation precludes the existence of a linear relation between contamination of plants and the average annual rate of precipitation. A two-compartment split model, considering both aerial and soil sources of Sr 90 in the food chain, was suitable for describing plant contamination. Analysis of the data concerning the Sr 90 content of separate components of the food chain showed that a linear relation exists between the Sr 90 contents of successive components of the food chain. From this, coefficients of proportionality can be determined for use in predicting the Sr 90 content of any component of the food chain. (tr-auth)

<260>

Dios Vidal, R., Radon-Generating Activity in Different Galician Soils in Relation to Other Great World Groups and the Total Lead Content. 1964. An. Edafol. Agrobiol., 23, 53-63 (Instituto Politecnico Espanol, Pontevedra, Spain)

Data are presented on the Radon 222-generating potential of different Galician prairie soils formed from granite and gneiss parent material, the mean annual rainfall being about 160 cm. Comparisons with a variety of major soil types throughout the world were made. The number of Ci of Radon 222 escaping from

2500 g of soil material, at equilibrium with its parent Ra, in some Galician soils is much greater than in the other soil types that were compared, reaching a maximum of 25×10^{-10} Ci/l of soil atmosphere activity or 96×10^{-14} Ci/g of dry soil. The middle and lower parts of the soil profile showed, in general, higher Rn-generating potentials but a low correlation was found between this and the clay fraction of the soil. However, the maximum activity corresponded with soils of higher (11 percent) clay content. Values of Rn released by the soil in boiling water-and ammonium hydroxide-treated suspensions are also given. The Rn-generating power of the ammonium hydroxide solution was greater than in the water suspensions and in untreated soil material. The accumulation of Pb in soils and its absorption by native plants, such as ULEX NANUS, PTERIS AQUILINA, and CARINEPHORUS CANESCENS, showed low correlation with Rn generation, even though the soils with highest Rn levels provided for most of the Pb concentration in soils and plants. (NSA)

<261>

Dlouhy, Z., Movement of Radionuclides in the Aerated Zone. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 241-249) (Nuclear Research Institute, Rez, Czechoslovakia)

Samples of selected natural materials were examined in detail, on a laboratory scale, under both batch and dynamic conditions and the results obtained were used to predict the behavior of selected radionuclides in the field experiments. Representative samples of Casaccia soil and Casaccia tuff (Cnen, Italy) were chosen. The main criteria to evaluate their retention of Cs, Sr, Ce, Zr, Nb, and Ru were the distribution coefficients (K), dispersion coefficients, porosity and permeability. Some variations of these factors were studied under laboratory conditions, i.e., the variation of Kd with pH, time, and composition of the eluting solution. However, the main effort was directed to elution experiments, which, by the application of chromatographic equations, Kd and dispersion coefficient data, provided a basis for a theoretical curve showing the radionuclide distribution in the profile. The field experiments with selected radionuclides were carried out with small cribs excavated in the ground. After several cubic meters of water had been passed through the contaminated bottom of the crib the distribution of the radionuclide was analyzed throughout the profile. In addition, experiments were made with Cs and Sr in cribs filled with a layer of the tuff. The results showed a small difference between the theoretical and experimental distributions of all the radionuclides studied. Dispersion was generally greater under field conditions and the peak of radioactivity moved faster than expected, perhaps due to a higher humic-acid content. Nevertheless, even a rough prediction of the important fission-product behavior is most valuable in the selection of a suitable disposal site. (Auth)

<262>

Dlouhy, Z., and J. Benes, Movement of Strontium 90 and Cesium 137 in Czechoslovak Soils. 1972. Jad. Energ., 18, 273-276 (Nuclear Research Institute, Rez, Czechoslovakia)

As a result of the examination of five of the most abundant soil types in Czechoslovakia,

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the sorption isotherms of strontium and cesium and the relative speeds of migration of Sr 90 and Cs 137 through these soils were determined, presenting also variances from the mean values. It was found that the radionuclides in question migrate much more slowly in soil than in water. Retention of radioactive nuclides in the soil reduces considerably the danger of contamination of the water supply in case of an accidental release of radioactivity. (NSA)

<263>

Dodd, J.D., The Biogeochemical Cycle of Cesium 134 in Two Native Stands of ANDROPOGON SCOPARIUS Mich., 1968. ORO-3488-8; 54 p. (Texas A&M University, Agricultural Experiment Station, College Station, TX)

ANDROPOGON SCOPARIUS crowns are a collection of individual plants. Concentrations of Cs 134 occurred in the roots and inflorescence. Transport of cesium from foliage to roots occurred with fall dormancy. Spring growth initiated export of cesium to the expanding leaf blades. Litter deposition throughfall, and root exudation were transfer mechanisms. Cesium was apparently fixed in the clay soil. In the less fertile sandy loam soil, plants continued to adsorb Cs 134, establishing a cycle. Cesium activity occurred in the soil to depths of 150 cm and radially to 180 cm. Movement was due to leaching of clay micelles and attached Cs 134 ions along cracks. High activity injections of K42 into A. SCOPARIUS tillers resulted in no visual damage, but transport blockage to the roots was indicated at 34 mCi. Leaf-sheaths were the concentrating organs in the vegetative tillers, even when K 42 was soil applied. Similar distribution patterns occurred for K 42 and Cs 134 in flowering tillers. Culm activity declined during dark periods and increased during light periods. Distribution of activity became more uniform in the tillers with time. Movement of $^3\text{H}_2\text{O}$ in pricklypear was dependent on time, plant phenology, and diurnal conditions. No moisture or activity was encountered in vapor samples during daylight hours. Developing pads showed high concentrations of activity. Center stringers imported activity earlier than laterals. (Auth)

<264>

Dolcater, D.L., Cation Exchange Selectivity and Mineralogy of Soil Clay Materials. 1970. Ph.D. Thesis; 123 p. (University of Wisconsin, Madison, WI)

Interactions involving structural and charge properties of layer silicate exchangers and cation properties such as valence, size, and hydration gave rise to variations in cation exchange equilibria. Cation exchange selectivity values were determined as the ratio of exchangeable cation equivalents displaced from an exchanger which had been equilibrated with a solution 0.005 M with respect to each of two competing cations. When Na saturated initially, biotite and muscovite gave KX/CaX values ranging from 0.9 to 1.7, compared to 0.1 to 0.3 for montmorillonite, micaceous vermiculite, and soil clays. The differences were attributed to the presence of varying amounts of interlayer wedge sites and varying layer charge density. Selectivity values with coarse clay muscovite ranged from $\text{KX}/\text{CaX} = 1.7$, through $\text{KX}/\text{SrX} = 1.3$, to $\text{KX}/\text{BaX} = 0.4$, varying with the degree of hydration of the cations, decreasing in the order Ca, Sr, and Ba. Vermiculite, as a result of limited expansion,

selectively adsorbed the divalent cation having the smallest unhydrated diameter ($\text{KX}/\text{CaX} = 2.7$, $\text{SrX}/\text{CaX} = 0.76$, and $\text{BaX}/\text{CaX} = 0.42$). Potassium saturation and drying of the samples resulted in decreased basal spacing of the expansible materials, lowered cation exchange capacity, and doubled KX/CaX selectivity values relative to those obtained for Na saturated, undried materials. These results indicated that the number of interlayer wedge sites was increased by K saturation and drying. After these treatments, the cation exchange capacities of micaceous vermiculite, biotite, and muscovite were similar (9.5, 7.7, and 9.7 meq/100 g, respectively); however, the KX/CaX selectivity values (0.4, 1.7, and 4.0, respectively) still varied widely. The differences in selectivity were attributed to the high layer charge density of mica relative to that of vermiculite. The higher KX/CaX selectivity of muscovite relative to biotite was explained by the smaller ditrigonal holes and the oblique orientation of hydroxyl groups in the muscovite structure. Titanium in the crystalline TiO_2 minerals, anatase and rutile, was differentiated from that isomorphously substituted into minerals dissolved by dihydrogen hexafluorotitanate (H_2TiF_6). Analyses of the original samples and the residues, by both wet chemical (Tiron) and neutron activation methods showed that 100 percent of the Ti in the synthetic anatase and 92 percent of the Ti in coarse clay sized rutile was in the residue. The latter value suggested that about 8 percent amorphous TiO_2 was removed from the mechanically dry ground rutile by the H_2TiF_6 reagent. An average of 86 percent of the titanium in seven kaolinite samples was present in the residue, largely anatase with some rutile as shown by x-ray diffraction. Only 28 percent of the Ti in two bentonites was present in the free TiO_2 form. The Ti present as crystalline TiO_2 in 40 soils and sediments ranged from 0 to 100 percent. Lyotropic cation exchange selectivity was greatly influenced by the number of interlayer wedge sites but also by variations in layer charge density. The combined effect resulted in the adsorption of 10 times as much K as Ca by muscovite compared to vermiculite and 40 times as much compared to montmorillonite. The layer charge density and cation exchange properties of minerals would be influenced by Ti isomorphously substituted into phyllosilicate layers. The several cation exchange factors of micaceous materials investigated undoubtedly influence their reaction with radioactive fallout products such as Cs 137 and Sr 90, and with radioactive wastes and other pollutants entering soils. (Auth)

<265>

Dolcater, D.L., E.G. Lotse, J.K. Syers, and M.L. Jackson, Cation Exchange Selectivity of Some Clay-Sized Minerals and Soil Materials. 1968. Soil Science Society of America Proceedings, 32, 795-798 (University of Wisconsin, Department of Soil Science, Madison, WI)

Cation exchange selectivity values for montmorillonite vermiculite, biotite, muscovite, and micaceous vermiculitic clays from Triangel and Harpster soils were determined by equilibration of each exchanger with a mixed, equinormal solution containing two competing cations. (Auth) (CWF)

<266>

Dolgikh, P.F., L.A. Vladimirov, and P.P. Yudin, Estimation of the Diffusion of Materials in Clayey Grounds. 1970, November. At. Energ.

<266> CONT.
(USSR). 29, 385-387

The diffusion-induced spreading of salts in water-resistant clay layers above and below the water table was determined, assuming that other phenomena, such as filtration, chemical interaction, and absorption play a relatively minor role. The solution of the problem requires an evaluation of the period required for a given diffusing material to reach the permissible mean annual concentration at a given distance from the porous layer of the water table. These diffusion times were calculated for the case of sodium nitrate. The method may be used to calculate diffusion of radioactive materials. As the mean annual permissible concentration of radioactive materials is usually very low, the coefficient alpha, expressing the ratio of this maximum permissible concentration in the aquifer and the original concentration of the material in the waste effluents was chosen as being 10⁻⁵), 10⁻⁶), and 10⁻⁹); the diffusion coefficients were assumed to be 0.01 and 0.0001 cm²/day. The results are presented in tabular form without, however, having taken the radioactive decay into account. The method may be used also to calculate the spreading of other materials, even of gases, by diffusion. (NSA)

<267>
Dolpoux, M., 'Comparison of the Radium and Uranium Contents of Plants Harvested on Uraniferous Land. 1970. CONF-690918-(Vol. 2); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 909-921), 506p. (University, Toulouse, France)

Earlier work established the radium contents of 20 species belonging to the spontaneous flora of uraniumiferous lands of the Monts d'Ambazac, Haute-Vienne (France). Later on, the same samples of plant ash were used to determine the uranium content. In both cases, where the ground is highly radioactive, the variation in the concentration of these radioelements is independent of that of their concentrations in the soils. There even seems to be a decrease in the uranium and radium absorption in the most radioactive stations. In addition, the ashes of the most radium-rich plants (for example VACCINIUM MYRTILLUS: 3757 x 10³ E-12 Ci per gram of ash) contain only 13 parts per million (ppm) of uranium whereas DESCHAMPSTIA FLEXUOSA (L.) TRIN., that is the richest in uranium amongst the species studied (185 ppm), only contains 440 x 10³ E-12 Ci of radium per gram of ash. For each species therefore the radium and uranium absorption exhibit a large degree of independence. The main phenomena brought to light are a double absorption selectivity (variation between species towards the same radioelement and different behavior of each species towards uranium and radium). This gives a possible explanation of the wide differences observed between individual plants and gives quantitative support to knowledge of the radioactivity peculiar to plants developing on uraniumiferous land. (Auth)

<268>
Droessmar, F., Polonium in Tobacco. 1967, August. Naturwiss. Rundsch., 20, 338

At the temperature range of 890 to 920 degrees centigrade produced by burning cigarette tobacco, the Po 210 it contains is vaporized and may be inhaled in the smoke. The Po 210 content of cigarette tobacco varies considerably with the locality in which it is

grown. Rhodesian tobacco contains 0.67 to 0.84 pCi/g, New Zealand tobacco 0.15 pCi/g, and the average for tobacco from South Africa and the southern U.S. is 0.49 pCi/g. The Po 210 concentration in rib bone ash of smokers is about 0.25 pCi/g, with a Pb 210 concentration of 0.285 pCi/g. For nonsmokers these values are lower, being 0.09 pCi/g for Po 210 and 0.135 pCi/g for Pb 210. The lung concentrations of these elements is approximately 100 percent greater in smokers than in nonsmokers. Concentrations as low as 0.3 pCi/kg blood can be measured after separation with HCl and ascorbic acid. (NSA)

<269>
Duckworth, R.B., and J. Hawthorn, Uptake and Distribution of Strontium in Vegetables and Cereals. 1960. J. Sci. Food Agr., 11, 218-225 (Royal College of Science and Technology, Department of Food Science, Glasgow, Scotland)

Experiments are described in which a range of cereals, root crops, and Brassicas was grown in sand using culture solutions containing strontium 89. The distribution of the tracer in the mature plants and in the different parts of the cereal grains is reported and illustrated using auto-radiography. The mode of uptake of fallout radiostrontium by plants in the field is discussed and the present results are interpreted in terms of the extent to which man's selection of particular parts of plants may affect the levels of radiostrontium in his own immediate diet. (Auth)

<270>
Dunigan, E.P., and C.W. Francis, Adsorption and Desorption of Cobalt 60, Strontium 85, and Cesium 137 on Soil Humic Acid. 1972. Soil Science, 114, 494-496 (Louisiana State University, Baton Rouge, LA)

Humic acid was isolated from the top 2.5 cm of the A horizon of an Emory silt loam soil. Preweighed samples of the prepared humic acid were washed twice with 25 ml of normal chloride solutions of Sr, Co, and Cs, labeled with Sr 85, Co 60, and Cs 137, respectively. Desorption studies were carried out using 4 washings of the humic acid. A strontium-humic acid equilibrium was established slowly. Addition of base increased the amount of Sr adsorbed. The opposite effect was noted with Co and Cs. More than 98% of the Sr 85 was removed by washings with salt solutions; 91 to 99% of the Co 60 was removed; varied results were obtained for Cs 137. (NSA)

<271>
Duric, D., M. Kilitarda, and D. Panov, Radioactive Cesium in the Biosphere and in Man. 1965. Higiiena, 17, 66-73 (Zavod na Mehielnu Rada, Belgrade, Yugoslavia)

The distribution and the hazards of radiocesium in the human environment are reviewed (68 references). Origin of Cesium 137 as a fission product in nuclear explosions is considered, and its transfer via food chains to animals and man is traced. Extensive data are provided on Cs 137 levels in water, soil, and plant and animal tissues in various parts of the world. Metabolic pathways of Cs 137, principally as a constituent of muscle with physiologic properties analogous to those of potassium, are surveyed and used as a basis for explaining its deposition in animals. Although it is not retained as tenaciously as radiostrontium, its long half life makes it

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one of the more serious fallout contaminant of the biosphere. The hazards of Cs 134, were considered to be less than those of Cs 137. Various methods and materials that may be used to accelerate the elimination of radiocesium from the body are also reviewed. (NSA)

<272>

Dutt, G.R., Effect of Small Amounts of Gypsum in Soils on the Solutes in Effluents. 1964. Soil Science Society of America Proceedings, 28, 754-757 (University of California, Department of Irrigation, Davis, CA)

Columns of soil initially containing exchangeable Ca and 0.0, 0.5, 1.0, and 2.0 percent of CaSO₄ - 2H₂O by weight were leached with a solution containing 50 me. MgCl₂ per liter. The effluents from these columns were collected and analyzed for Ca, Mg and Na. The breakthrough curves for Na were not affected significantly by the presence of gypsum; however, the curves for Mg were dependent on the amount of CaSO₄ - 2H₂O present in the system. (Auth) (CWF)

<273>

Dutt, G.R., and K.K. Tanti, Predicting Concentrations of Solutes in Water Percolated through a Column of Soil. 1962. J. Geophys. Res., 67, 3437-3439 (University of California, Department of Irrigation, Davis, CA)

A procedure was developed for calculating the concentration of solutes present in water leached through soils containing gypsum and exchangeable calcium and magnesium. The theoretical results are compared with experimentally determined values. It is apparent that diffusion of Mg caused variation between some of the calculated and measured values; the predicted values, however, are sufficiently close to the measured concentrations to be useful in most investigations. (Auth) (CWF)

<274>

Dyck, W., Uranium Exploration Using Radon in Soils. 1969. Can. Mining J., 90, 45-49

Highlights of tests carried out during the 1968 field season to determine the applicability of the radon method for detailed prospecting for U are given. Where the overburden is one to two feet thick, on-site radon and thoron determinations in soil emanations in the Gatineau hills outlined radioactive pegmatites more clearly than did x-ray tests. In general the radon method outlined radioactive sources more clearly than did the Geiger counter. On-site radon-thoron emanations were determined with a portable counter using ZnS (silver activated) cell modified in such a way as to permit the flow of soil gas through it. These gases were obtained from one to two feet deep holes punched into the soil with a needle bar. (NSA)

<275>

Eberhardt, L.L., Variability of the Strontium 90 and Cesium 137 Burden of Native Plants and Animals. 1964. Nature, 204, 238-240 (Hanford Laboratories, Richland, WA)

Plant and animal analyses of strontium and cesium fallout show rather small variations in concentrations within a small sample area. (CWF)

<276>

Eberhardt, L.L., Modeling Radionuclides and Pesticides in Food Chains. 1971. BNWL-SA-3873; CONF-710501; Part of Proceedings of the Third National Symposium on Radioecology held in Oak Ridge, Tennessee, May 10-12, 1971, 13 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Some aspects of modelling the kinetics of trace substances, such as pesticides and radioisotopes, in food chains are discussed. The problems of sampling in space, time, and systems are considered in light of some case-histories and a food-chain simulation model. (Auth)

<277>

Eberhardt, L.L., W.H. Rickard, C.E. Cushing, D.G. Watson, and W.C. Hanson, Study of Fallout Cesium 137 in the Pacific Northwest. 1969. J. Wildlife Manage., 33, 103-112 (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

The seasonal and spatial distribution of fallout cesium 137 was measured in a number of ungulates and selected forage plants with emphasis on Douglas fir, bluebunch wheat grass, antelope, elk, domestic sheep, and mule deer. Study sites ranged from southwestern Wyoming to the Washington coast, including two different seasonal precipitation regimes with annual totals from about 7 in to over 100 in. Radionuclide accumulation in fallout collectors followed the seasonal patterns of precipitation, as did concentrations on vegetation and in animals. Many factors influence the specific expression of these general patterns, and it is suggested that the overall variability and complexity are such that a useful investigation of any contaminant in a natural system requires a sizable minimum expenditure of effort. (NSA)

<278>

Eckert, R.E., Jr., and C.R. Blincoe, Radioisotope Uptake by Selected Range Forage and Weed Species. 1970, September. J. Range Manage., 23, 367-379 (University of Nevada, Reno, Nevada)

Two wheatgrasses, one annual grass, and one annual forb were used to evaluate the uptake of fourteen gamma emitting isotopes from soil. Uptake of copper, molybdenum, and selenium ranged from moderate to very good from all soil horizons. Uptake of iodine and chromium was poor from the surface and lower soil horizons, respectively, but moderate to very good from other horizons. Other desirable characteristics of these isotopes for root-tracing studies are half-lives of from 12.8 hours to 128 days, and energy differences that permit detection of each isotope in the presence of others. (Auth)

<279>

Edmisten, J., Soil Studies in the El Verde Rain Forest. TID-24270; Part of Odum, H.T. and Pigeon, R.F. (Eds.), A Tropical Rain Forest, (p. H. 79-87) (University of West Florida, Department of Biology, Pensacola, FL)

Some physical and chemical properties of tropical rain forest soils at El Verde, Puerto Rico, were investigated before and after treatments with gamma radiation from a Cs 137 source and after mechanical defoliation of the vegetation. Flushes of soil ions were observed in soils after treatment, subsequently, ionic concentrations were lower than they were at the start. The profiles of

<279> CONT.

cations indicated heterogeneous patterns with both podzolization and laterization active. Infiltration rates for the relatively undisturbed soils studied were unusually high (30 and 60 cm/hr) when associated with low bulk density. Lower infiltration rates and higher bulk-density values were associated with level areas rather than with slopes. (Auth)

<280>

Edvarson, K., L. Ekman, A. Eriksson, L. Fredriksson, and U. Greitz, Studies on the Relationship Between Iodine 131 Deposited on Pasture and Its Concentration in Milk. 1965. July. FOA-4-A-4438-4623 (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden; Royal Veterinary College, Department of Clinical Biochemistry, Stockholm, Sweden)

An experimental study was carried out to investigate the relationship between a given deposition of radioiodine on pasture and the subsequent levels of radioiodine in fresh milk from cows grazing on contaminated pasture. (Auth) (CWF)

<281>

Egorov, A.V., V.M. Klechkovskii, and L.M. Sokolova, The Effects of Nitrogen Supply Conditions on the Uptake of Strontium 90 by Plants from the Soil. 1969. A-AC-82/G/L-1289; 11 p. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

Oat, pea, and lettuce plants were given nitrogen doses of 15, 75, 375 and 750 mg of nitrogen per 4 kg of sand. Sharp increases in plant yield were noted for the salad and oat plants, but not for the pea plants. No correlation between nitrogen dose and strontium accumulation could be observed for the lettuce plants, but a maximum in strontium 90 accumulation was noted at a nitrogen dose of 375 mg of nitrogen per 4 kg of sand. The strontium 90 content in the chaff and grain of the oat plants is decreased with increasing nitrogen dose. The pea showed strontium 90 accumulation only at the highest nitrogen dose of 750 mg of nitrogen per 4 kg of sand. (NSA)

<282>

El-Sheikh, A.M., and A. Ulrich, Interactions of Rubidium, Sodium, and Potassium on the Nutrition of Sugar Beet Plants. 1970. Plant Physiology, 46, 645-649 (University of California, Department of Soils, Berkeley, CA)

The effect of Rb on the growth and the development of sugar beet plants depends on the Rb concentration, the K supply, and the relative abundance of Na. (Auth) (CWF)

<283>

Elgawhary, S.M., and S.A. Barber, Differential Strontium-Cadmium Bonding on Soil as Influenced by Bonding Site. 1971. Soil Science Society of America Proceedings, 35, 566-571 (Purdue University, Agriculture Experiment Station, Lafayette, IN)

The Sr-Ca selectivity coefficient, $k_{\text{sub Sr/Ca}}$, was used to interpret the differential Sr-Ca bonding of cation exchange sites in two soils. A dominant complementary cation, K, was used to place the Sr and Ca on sites which favored Sr and Ca over K. As the equivalent fraction of Sr plus Ca and $k_{\text{sub Sr/Ca}}$ that was linear over segments of the range of equivalent fraction used. Chromatographic

separation of Sr plus Ca and $k_{\text{sub Sr/Ca}}$ that was linear over segments of the range of equivalent fraction used. Chromatographic separation of Sr plus Ca and $k_{\text{sub Sr/Ca}}$ that was linear over segments of the range of equivalent fraction used. Chromatographic separation of Sr plus Ca in the equilibrium solution was reduced, $k_{\text{sub Sr/Ca}}$ decreased, indicating that organic exchange sites were the first to be filled. When the complementary ion was Mg or Ba, $k_{\text{sub Sr/Ca}}$ was much larger, indicating that these complementary ions competed more nearly equally with Sr and Ca for all exchange sites. There was a relationship between the log of the equivalent fraction of Sr and Ca on a Sidell soil reflected the $k_{\text{sub Sr/Ca}}$ of this soil at low Sr plus Ca saturations. Little Sr and Ca separation occurred with the Edwards much apparently because of the over-shadowing of the readily exchangeable cations by Sr and Ca adsorbed in very slowly exchangeable positions resulting in little movement of these ions. (Auth)

<284>

Elgawhary, S.M., G.L. Halzer, and S.A. Barber, Calcium and Strontium Transport to Plant Roots. 1972. Soil Science Society of America Proceedings, 36, 794-799 (Purdue University, Lafayette, IN)

Mass-flow and diffusion of Ca and Sr to tomato (LYCOPERSICON ESCULENTUM) roots were studied in two exchange resin rooting media. Six harvests were made from plants grown over a 26-day period under low and high humidities in a growth chamber. With low humidity, the rate of supply to Ca and Sr by mass-flow exceeded uptake rate during the entire growth period. Under high humidity, the rate of mass-flow supply exceeded uptake only until the second harvest, thereafter diffusion became the dominant supply mechanism. The Ca/Sr ratio of uptake was compared with the Ca/Sr ratios on the resins and in solutions to determine the source of Ca and Sr. Supply by mass-flow came from the solution, whereas supply by diffusion apparently came mainly from the exchangeable fraction indicating exchange diffusion was important. Both log of root length and log of water uptake were linearly correlated with time for the 26-day growth period investigated. The rate of water absorption ranged from 1.1×10^{-7} to 6.0×10^{-7} cm³/cm of root per sec. The root uptake coefficient for Ca uptake varied between 1.43×10^{-6} and 2.72×10^{-6} cm/sec and for Sr 1.0×10^{-6} to 2.38×10^{-6} cm/sec where an average root radius of 0.015 cm was used in the calculations. (Auth)

<285>

Eliason, J.R., Earth Sciences Waste Disposal Investigations, January-June 1967. 1967. BNWL-687; 18 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Ground water samples were analyzed for gross beta activity, for Rh 106-Bu 106, and alpha activity of Cs 137, H 3, and Sr 90. Gross beta and tritium results are plotted on water table contour maps with iso-concentration lines showing two-dimensional extent and direction of contamination spread. Disposal of waste to ground water has caused changes in quality of ground water due to salts in the wastes and mineral degradation in the soils. Concentrations of nonradioactive materials in the ground water are below recommended drinking water levels except for nitrates which are above the 45 ppm limit. (NSA)

<286>

Ellis, F.B., and E.R. Mercer, The Effect of Applying Lime to Pastures on the Extent to Which Strontium 90 Enters Milk under Conditions of World-Wide Fallout. 1964. ARCRL-12; (p. 65-67) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

In the summer of 1963 lime was applied to pastures on a small group of farms on which cattle would graze during part of the summer and trends in the contamination of milk with Sr 90 were compared with those in milk from farms where no lime had been applied in the recent past. Weapons tested during 1961 and 1962 led to appreciable fallout during this period. Wide variations in seasonal trends occurred between individual farms in both groups, but comparison of the mean values suggested that the application of lime depressed the Sr 90/Ca ratio in milk by 10 to 20% in the six weeks after the lime was applied. It was concluded that the application of lime in this manner was not a good remedial measure at times when the rate of fallout is rising steeply. (ST)

<287>

Ellis, F.B., E.R. Mercer, and G.M. Milbourn, The Contamination of Grassland with Radioactive Strontium. II. Effect of Lime and Cultivation on the Levels of Strontium 90 in Herbage. 1968. Radiation Botany, 8, 269-284 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

The effect of applying lime to permanent pastures and of replanting them and the contamination of herbage with radioactive strontium has been studied in field experiments under a wide range of conditions in the United Kingdom. In accordance with the findings in other investigations the results suggest that about one quarter of the radioactive strontium deposited on established pastures is likely to be retained on edible tissues. (Auth) (CWF)

<288>

Emmert, F.H., Ion Interactions in Plant Tissues, Progress Report, January 1963 - January 1964. 1964. TID-19498 (University of Connecticut, Agriculture Experiment Station, Storrs, CT)

Progress is reported in a study of nutrient ion uptake by plants from soil and ion interactions in plant tissues. Data are included from investigations on water utilization and Sr discrimination by plants and ion penetration of plant roots. Sr 89, Ca 45 and P 32 were used as tracer in these studies. (NSA)

<289>

Emmert, F.H., Retention and Passage of Calcium and Strontium in Stems of PHASEOLUS VULGARIS as Mediated by Xylem Stream Flow Rate and Dinitrophenol. 1969. Physiologia Plantarum, 22, 246-252 (University of Connecticut, Storrs, CT)

The passage and retention of Ca 45 and Sr 89 were studied in the stem as influenced by flow rate of the ascending stream, and also by introduction of the respiratory inhibitor 2,4-dinitrophenol to the stream. Solutions containing 6000 cpm/ul Ca 45 or 4000 cpm/ul Sr 89 were forced through the bean stem sections, and solute which completed passage to the exudate was considered indicative of the nutrition normally available to the plant top. Tests were conducted over 2 widely different xylem stream flow rates, and with or without

the addition of dinitrophenol to the source solution. Approximately identical amounts of Ca 45 or Sr 89 were introduced into the stem for all test situations. In all cases, the stem retained the bulk of introduced Ca 45 and Sr 89 and allowed only a fraction (approximately 25 percent) to complete passage to the exudate. Stream flow rate influenced the extent of retention. At the high (vs the low) flow rate, less Ca 45 and Sr 89 (either as absolute or percent values) were retained in the stem and a corresponding greater amount passed to the exudate. The relative behavior of Sr 89 to Ca 45 is shown by the Observed Ratio Sr/Ca (O.R.): O.R. Sr 89, Ca 45 = (Ratio: Sr 89/Ca 45 sample)/Ratio: Sr 89/Ca 45 precursor). An O.R. greater than 1.0 indicates an increase in Sr to Ca in the sample relative to the precursor. Conversely, a value below 1.0 denotes a decrease in Sr to Ca in the sample relative to the precursor. Stem O.R. values exceeded 1.0 under both flow rates. A preferential retention of Sr 89 over Ca 45 in the stem is thus indicated. Such discrimination was increased by 2,4-dinitrophenol. (NSA)

<290>

Enfield, C.G., An Irreversible Thermodynamic Approach to Simultaneous Movement of Water, Heat, and Salt Through Unsaturated Soils. 1970, August. BNWL-1429; 42 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Literature was reviewed to obtain the basis for the simultaneous flow of water, heat, and salt through unsaturated soils. Flow theories were developed from the general theory of water flow in saturated soil under isothermal conditions to the analysis of simultaneous solution flow caused by two driving forces, such as water and heat, using irreversible thermodynamics. Based on this review, conclusions were made that the theory of irreversible thermodynamics is the most applicable approach for modeling when both liquid and vapor transport are to be considered. (Auth)

<291>

Epstein, E., The Essential Role of Calcium in Selective Cation Transport by Plant Cells. 1961. Plant Physiology, 2, 437-444 (University of California, Department of Soils and Plant Nutrition, Davis, CA)

Excised barley roots were used to study the influence of potassium and sodium on the uptake of each other in the presence and absence of calcium. In the absence of calcium, sodium interferes with potassium absorption and potassium with sodium while in the presence of calcium, potassium interferes with sodium absorption only at low potassium concentrations. As the potassium concentration is increased the inhibition of sodium for each added increment of potassium becomes very small. At low sodium concentrations (1-2 mM), sodium interferes slightly with potassium absorption in the presence of calcium. (CWF)

<292>

Epstein, E., Mineral Nutrition of Plants: Mechanisms of Uptake and Transport. 1956. Ann. Rev. Plant Physiol., 7, 1-24 (U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD)

A review is given of the literature pertaining to the mechanisms involved in plant uptake and

<292> CONT.

transport through the plant. Passive and active processes are defined in this review. (CWF)

<293>

Epstein, E., and J.E. Legett, The Absorption of Alkaline Earth Cations by Barley Roots: Kinetics and Mechanism. 1954. American Journal of Botany, 41, 785-791 (U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD)

Experiments are described on the absorption and mutual interference of alkaline earth cations by excised barley roots. Strontium labeled with Sr 90 was used. Two modes of uptake are distinguished: 1) exchange adsorption, in which the root acts as a cation exchanger, and 2) active transport of the ions mediated by metabolic processes. The two processes differ in attributes relating to kinetics, reversibility, ion specificity, and energy requirements. In regard to active transport, which constitutes the process of absorption proper, the findings are consistent with the hypothesis that it involves intermediate compound formation between the ions and "binding compounds" or "carriers." The ions Ca, Sr, and Ba compete for identical binding sites or reactive centers on the carriers. The Mg ion does not compete for these sites. (Auth)

<294>

Eremin, N.N., Natural Radioactivity of the Schirmacher Ponds. 1965. Sov. Antarct. Exped. Inform. Bull., 5(55), 18-19

The Ninth Soviet Antarctic Expedition made observations at Novolazarevskaya Station of the natural radioactivity of settling dusts and aerosols by the sedimentation method (with trays), as well as of precipitation (water, snow, and ice), soil and vegetation (mosses, lichens, and algae). The activity of settling dusts and aerosols was examined as a function of wind velocity and the amount of precipitation. Maximum activity was recorded in October ($7.0 \times 10(E-4)$ Ci/km²/month) when maximum mean monthly wind speed and the maximum amount of precipitation were also recorded. There was a marked decrease in the beta activity of precipitation from August to October (from $8.1 \times 10(E-8)$ to $0.2 \times 10(E-10)$ Ci/l), probably associated with atmospheric circulation and also dependent on the region of the earth from which a particular air mass arrived. The results of measurements of the beta activity of water from the lakes in the Schirmacher Ponds and of land ice were all beyond the limits of accuracy of the measuring equipment, i.e., below $10(E-15)$ Ci/l, or below $10(E-15)$ Ci/kg. Substantial fluctuations of the beta activity of soils were associated with the type of ground. All sandy soils had an activity of the order of $10(E-15)$ Ci/kg and less. Disintegrated rocks and soil had the highest activity. The activity of vegetation was of the same order of magnitude as that of the soil where it was collected. The activity of mosses and lichens in other parts of the world is one order of magnitude higher ($10(E-7)$ Ci/kg) than in the Schirmacher Ponds. It was concluded that the natural radioactivity of the Schirmacher Ponds is substantially lower than in the rest of the world. (NSA)

<295>

Erhardt, W.H., Polonium 210 Contents of Plant Tissue and the Use of Metal Ammonium Phosphates

as Vegetable Crop Fertilizers. 1966. Ph.D Thesis; 157 p. (University of Wisconsin, Madison, WI)

Methods for the determination of Po 210 in plant tissues were evaluated. Several samples of the edible portion of vegetables (fresh), cured and uncured (green) tobacco leaf tissues, and other dead plant materials were analyzed for Po 210 content. Although detectable amounts of Po 210 were not found in the fresh vegetables and green tobacco leaf samples, significant amounts were found in cured leaf tobacco, dead bluegrass, tree leaf, and alfalfa samples. Substantial quantities of Po 210 were found in all the soils tested. The soil organic matter and Po 210 contents were not related. Therefore, it was concluded that accumulation of Po 210 in vegetative materials must occur after the plants die. Greenhouse and field studies were conducted to evaluate metal ammonium phosphates as vegetable crop fertilizers. (NSA)

<296>

Essington, E.H., and H. Nishita, Effect of Chelates on the Movement of Fission Products through Soil Columns. 1966. Plant and Soil, 24, 1-23 (University of California, Los Angeles, CA)

The effect of a number of chelating agents present in distilled water, and mock irrigation water, were studied as to the movement of radionuclides from columns of calcareous soil. (CWF)

<297>

Essington, E.H., H. Nishita, and A.J. Steen, Release and Movement of Radionuclides in Soils Contaminated with Fallout Material from an Underground Thermonuclear Detonation. 1965. Health Physics, 11, 689-698 (University of California, Los Angeles, CA)

Fallout material from an underground thermonuclear detonation was analyzed to determine the presence of several longer lived radionuclides. Radiotungsten contributed the major fraction of the total activity. In suspension studies, chelating agents as compared to water generally increased the amount of soluble radionuclides but the effect was small. The effect of water and a chelating agent on the movement of radionuclides in soil columns was also studied. (Auth) (CWF)

<298>

Essington, E.H., H. Nishita, and A. Wallace, Influence of Chelates on Availability of Fission Products to Plants Grown in a Contaminated Soil. 1962. Soil Science, 94, 96-105 (University of California, Los Angeles, CA)

In an experiment to test the influence of chelate application to a calcareous soil on the uptake of radionuclides in bean plants, it was found that plant uptake of Sr 90 and Cs 137 was unchanged. (CWF)

<299>

Essington, E.H., H. Nishita, and A. Wallace, Effect of Chelating Agents on the Uptake of Yttrium 91, Ruthenium 106, Cerium 144, and Promethium 147 by Beans Grown in a Calcareous Soil. 1963. Soil Science, 95, 331-337 (University of California, Los Angeles, CA)

The effect of three chelating agents (DTPA, CDTA and EDDHA) were evaluated in uptake of Y 91, Ru 106, Ce 144 and Pm 147 from a

<299> CONT.

calcareous soil by bean plants. The concentration of Y 91, Ce 144 and Pa 147 was increased in plant parts by soil applications of DTPA chelate. Y and Pa uptake was increased by CDTA and to some degree by EDDHA amendments. Ce and Ru were the least affected by chelate applications. Paper chromatography data indicated the existence of Y 91-DTPA complexes in bean leaves. (CWF)

<300>

Evans, E.J., and A.J. Dekker, The Effect of Potassium Fertilization on the Strontium 90 Content of Crops. 1963. Can. J. Soil Sci., 43, 309-315 (Canada Department of Agriculture, Soil Research Institute, Ottawa, Ontario, Canada)

Three soils were used in greenhouse experiments to determine the effect of KCl and potassium carbonate on the Sr 90 concentration in oats, alfalfa, and timothy. In addition soils were moist incubated to determine the effects of similar potassium treatments on water soluble Sr 90, calcium, and potassium. The general trend of results found in the greenhouse experiments was that increasing levels of added potassium caused decreases in calcium, magnesium, and Sr 90 contents and increases in potassium contents of the crops. The decreases of Sr 90 were frequently greater when potassium was applied as the carbonate compared with its addition as the chloride. (Auth) (CWF)

<301>

Evans, E.J., and A.J. Dekker, Use of Soil Contaminated with Strontium 90 for Seed Production. 1967. Can. J. Plant Sci., 47, 319-320 (Canada Department of Agriculture, Soil Research Institute, Ottawa, Ontario, Canada)

Second generation seed from four crops previously grown on Sr and Y 90 contaminated soil showed no radioactivity indicative of Sr or Y 90 when grown in an uncontaminated environment. (CWF)

<302>

Evans, E.J., and A.J. Dekker, Effect of Nitrogen on Cesium 137 in Soils and Its Uptake by Oat Plants. 1969. Can. J. Soil Sci., 49, 349-355 (Canada Department of Agriculture, Ottawa, Ontario, Canada)

In an experiment designed to show the effects of time of addition of NH₄ relative to Cs 137 and of ammonia compared with nitrate nitrogen the results showed conclusively that ammonium caused higher Cs 137 concentration in oats than did the nitrate form of nitrogen at low soil K contents. The results were less conclusive for soils to which K had been applied. (Auth) (CWF)

<303>

Evans, E.J., and A.J. Dekker, Strontium 90 Concentration in Deep and Shallow-Rooting Species as Affected by Placement of Strontium 90 and Fertilizer in the Soil. 1965. Can. J. Soil Sci., 45, 289-296 (Canada Department of Agriculture, Ottawa, Ontario, Canada)

In greenhouse experiments involving the placement of Sr 90 and fertilizer in the soil, marked reductions in Sr 90 concentration were found for timothy and wheat when the Sr 90 was placed deep in the soil compared with the results found for shallow placement. Fertilization of the soil above the zone of Sr 90 contamination led to further decreases in

Sr 90 concentration in timothy and wheat. (Auth) (CWF)

<304>

Evans, E.J., and A.J. Dekker, Foliar, Floral, and Root Absorption of Strontium by Crops. 1965. Agronomy Journal, 57, 82-83 (Canada Department of Agriculture, Ottawa, Ontario, Canada)

In a field experiment carried out to determine the relative Sr 90 content of wheat, oats, alfalfa, and timothy grown in the open compared with that of the same crops grown under clear plastic tents, absorption of Sr for the uncovered crops exceeded that of the covered crops. (Auth) (CWF)

<305>

Evans, E.J., and A.J. Dekker, The Fixation and Plant Recovery of Cesium 137. 1969. Soil Science, 107, 175-180 (Canada Department of Agriculture, Ottawa, Ontario, Canada)

A study was conducted to evaluate the cesium reaction product in two soils through chemical extraction techniques and plant uptake studies. Alternate wetting and drying of soils fixed more Cs than did moist incubation or dry incubation at 0, 36 and 75 degree Fahrenheit. Of the magnesium, ammonium, calcium, potassium and aluminum chloride salts used to extract Cs 137 from the contaminated soil ammonium and potassium salts extracted much larger amounts. However, appreciable Cs 137 was taken up by oats from samples previously extracted with potassium and ammonium salts. This showed that soluble cesium added to soil but fixed against selective cation extraction was available to plants. The authors concluded that residual ammonium after extraction stimulated plant uptake of Cs 137. (CWF)

<306>

Evans, E.J., and A.J. Dekker, Comparative Cesium 137 Content of Agricultural Crops Grown in a Contaminated Soil. 1968. Can. J. Plant Sci., 48, 183-188 (Canada Department of Agriculture, Ottawa, Ontario, Canada)

Cereal, forage and vegetable crops grown in a loam soil in a greenhouse experiment varied in the relative concentration and uptake of Cs 137 but took up only a small percentage of the Cs 137 dose applied. The proportion of added dose taken up by sugar beet tops, the highest of any crop investigated, was only 0.13 percent. (Auth) (CWF)

<307>

Evans, E.J., and A.J. Dekker, Influence of Rate of Strontium 90 Added to Soil at Different Phosphate Levels on the Concentration of Strontium 90 in Plants. 1965. Can. J. Plant Sci., 45, 375-378 (Canada Department of Agriculture, Soil Research Institute, Ottawa, Ontario, Canada)

In a greenhouse experiment designed to show the effects of monocalcium phosphate and rate of Sr 90 added to soil on the concentration of Sr 90 in oats and alfalfa, a reduction in Sr 90 concentration in oats of about 50 percent was effected on Grenville soil by the addition of 0.546 g per 2.5 kilo soil. It is believed that the reduction was caused partly by the effect of calcium in the fertilizer and partly by the dilution caused by a very large increase in yield from the application of the fertilizer. (CWF)

<308>

Evans, E.J., and A.J. Dekker, The Influence of Soil Properties and Soil Amendments on the Strontium 90 Content of Oats Grown in Selected Canadian Soils. 1962. Can. J. Soil Sci., 42, 23-30 (Canada Department of Agriculture, Ottawa, Ontario, Canada)

Oats were grown in the greenhouse in six soils varying widely in pH, organic matter content, CEC, percent saturation, and exchangeable calcium. Strontium 90 was added to all soils and its concentration in oats, as influenced by soil properties or soil treatment, was determined. (Auth) (CWF)

<309>

Eynard, I., Studies on the Translocation of Foliar-Applied Cesium 137 and Phosphorus 32 in VITIS VINIFERA L.. 1961. Nuovo Giorn. Botan. Ital., 68, 393-398

Cesium 137 and Phosphorus 32 were simultaneously applied to four apical leaves on one branch of Emperor grape seedling characterized by two twin identical shoots. The samples harvested 24 hr after (from the treated branch), showed that the ratio of Cesium 137 and Phosphorus 32 decreased, pointing out different and independent rates of translocation in the phloem, 48 hours after treatment. In the leaves taken from the untreated branch and in the root, the ratio was almost constant. (Auth)

<310>

Farah, M.Y., S. Abdel-Gawad, and E. Metry, Investigation on Sorption of Strontium and Cesium by Soils of Borq El-Arab District. 1969. Health Physics, 17, 711-715 (Atomic Energy Establishment, Nuclear Chemistry Department, Inshas, United Arab Republic)

Studies were carried out to evaluate the effectiveness of Borq El-Arab soil samples for the concentration of fission products from liquid wastes. The sorption of cesium and strontium was investigated. With each isotope the exchange capacity, distribution coefficient and selectivity coefficient was determined. Also the effect of other factors such as pH, the concentration of chemically similar elements present in solution and heat treatment of the samples was studied. (Auth)

<311>

Farris, G.C., Factors Influencing the Accumulation of Strontium 90, Stable Strontium, and Calcium in Mule Deer. 1967. Ph.D. Thesis, 205 p. (Colorado State University, Fort Collins, CO)

Concentrations of Sr 90, stable strontium, and calcium were measured in mule deer bone and in eight forage species that were sampled over a five year period from the Cache la Poudre drainage in north central Colorado. Vegetation was collected from sampling points within each of the major plant communities utilized by deer. A definite temporal trend in Sr 90 concentrations in plants and bones of fawn and yearling deer was observed from 1961 to 1965. Plants and deer reached peak Sr 90 concentrations in 1963 with decreases in activity in 1964 and 1965. Summer forage plants were generally higher in Sr 90, stable strontium, and calcium levels than in those species available to the deer in the winter. However, more variation was observed between species and locations of summer range plants than in winter range plants. Comparisons were made on Sr 90, stable strontium, and calcium

levels observed in forage and deer rumen contents. Yearly mean ratios were similar indicating the isotope content of plants sampled was representative of the actual consumption of deer. Stable strontium levels in deer bone ranged from 0.184 to 0.632 mg Sr/g ash. Lower stable strontium concentrations were observed in fawns than in mature deer. No significant differences in Sr 90, stable strontium and calcium concentrations were observed between the sexes of deer. Observed ratios (Sr/Ca in bone + Sr/Ca in diet) of 0.316, 0.183 and 0.189 were calculated for fawn, yearling and adult deer, respectively. Annual turnover rates of strontium in bone were estimated as 32 percent for yearling and 7 percent for adult deer. A mathematical equation was used to calculate Sr 90 concentrations in the bones of deer as a function of their age. Predicted Sr 90 concentrations agreed well with the observed data. (Auth)

<312>

Faure, J., Role of the Organic Matter of a Waterway with Regard to the Radioactive Pollution: Influence of the Extraction Process on the Splitting and Behavior of Chemical Elements with Regard to the Organic Matter. 1973. CEA-R-4443; 50 p. (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Cadarache, France)

The comparison between three methods of extraction using soda solutions with respective normalities of 10 (E-1), 10 (E-2), and 0.5 - 0.10 (E-2) N reveals that the second one shows a degree of efficiency practically as high as the first one, whereas the third one is distinctly less efficient. On the other hand, splittings obtained by gel chromatography seem to bear evidence of the degradation of the organic substances extracted by soda 10 (E-1) N and ion-exchanger resins, which lead us to recommend the use of the solution 10 (E-2) N. (Auth)

<313>

Fedorov, E.A., B.S. Prister, G.N. Romanov, and N.I. Burav, Biological Effects and Behavior of Radioactive Fission Products in the Agriculture Chains. 1971, June. A/CONF-49/P-686; CONF-710901; Part of Proceedings of the Fourth International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 6-16, 1971, 21 p. (State Atomic Energy Committee, USSR)

Agricultural aspects of the radiation situation which can occur in the case of the environmental contamination with a mixture of fission products of various ages and following neutron soil activation are considered. Experimental data are presented which were obtained in investigations conducted under natural conditions and on experimental areas. A connection is established between the density of radioactive contamination of agricultural lands with a fresh mixture of fission products, the degree of radionuclide accumulation in the farm crops following their contamination during different phases of their growth, and the doses of gamma and contact beta-radiation received by plants and subsequent radiation injury of farm crop seedlings. (Auth)

<314>

Fedorov, E.A., and G.N. Romanov, Quantitative Characteristics of the Relation between the Environmental Contamination Levels and Radioisotope Concentrations in Selected Types of

<314> CONT.
Farm Produce. 1970, April 15. A-AC-82/G/L-1286;
AEC-tr-7128; (p. 112-126) (Gosudarstvennyi
Komitet Po Ispol'zovaniyu Atsnoi Energii SSSR,
Moscow, USSR)

Studies on the effects of the environment on radioisotopes and the effects of global fallout on contamination levels of farm produce led to the determination of proportionality factors for certain farm products. Establishment of these quantities made it possible to estimate the contamination of farm products for known levels of radioactive fallout and a known content of radioisotopes in the soil. Tables are presented to show soil proportionality factors for Cs 137, Ce 144, Ru 106, Sr 89, and Sr 90 in hay, wheat, leafy vegetables, potatoes, and root vegetables. Data on uranium concentrations in farm crops show that there is a close relationship to the content of the available form of the uranium in the soil. A formula is presented for determining the air proportionality factor for I 131. Ratios between levels of Sr 90 and Cs 137 contents of milk and fallout levels were studied. (NSA)

<315>
Fedorov, G.A., I.E. Konstantinov, A.D. Romyantsev, and V.F. Brendakov, Character of the Vertical Distribution of Cesium 137 in Soil in Certain Areas of the Soviet Union, 1966-1967. A-AC-82/G/L-1256; AEC-tr-7030; (p. 145-148)

The vertical distribution of Cs 137 in soil at four sites in the USSR was measured in 1966 and 1967 and compared with similar data acquired before 1961. The sampling and measurement procedures are described. The results indicate that Cs 137 activity decreased more rapidly with depth than dose Sr 90 activity and is practically all concentrated in an upper layer 2 cm deep (NSA) (CWF)

<316>
Feige, Y., B.G. Oitman, and J. Kastner, Production Rates of Neutrons in Soils Due to Natural Radioactivity. 1968, May. J. Geophys. Res., 73, 3135-3142 (Argonne National Laboratory, Argonne, IL)

The relative neutron yield of several targets of light elements exposed to monoenergetic ionized helium beams from the Argonne tandem accelerator was determined for alpha energies ranging from 4.8 to 8.8 MeV. The neutron yields for 5.3 MeV were in agreement with published data on thick target yields obtained with Po 210 alpha particles. The average (alpha,n) yield per alpha particle of the natural radioactive series for some elements and for different soil compositions was calculated assuming an (alpha,n) yield of 75 neutrons per 10⁴ (E+8) alpha particles of Po 210 alpha for aluminum. If 3 ppm U 238 and 11 ppm Th 232 are assumed as representative of the earth's upper crust, a production rate of 6.7 plus or minus 0.7 n/q/yr in sand and 13.5 plus or minus 1.3 n/q/yr in granite is obtained. Additional 1.4 n/q/yr will be generated because of the spontaneous fission of U 238. As the production rate of neutrons through interactions of cosmic rays with the earth's surface at sea level is of the order of 800 n/q/yr, these (alpha,n) reactions cannot be of any significance to exposure rates of human populations. They may be of some interest to geologists, however, and may be the main contributors to neutron fluxes in tunnels, deep caves, or mines, where cosmic-ray background is very low. (Auth)

<317>
Felten, E.J., D.E. Fornwalt, and A.V. Karg, The Preparation and Properties of the Rutile Phase - A Vanadium Titanium Oxide Compound. 1970. Journal of Solid State Chemistry, 2, 295-298 (Pratt and Whitney Aircraft, Division of United Aircraft Corporation, Advanced Materials Research and Development Laboratory, Middletown, CT)

A new mixed oxide V(III) Ta(V)O₄ has been prepared by reacting V₂O₃ with Ta₂O₅ in a reducing atmosphere between 1400 and 1600 degrees C. VTaO₄ crystallizes in the rutile structure, with a=4.68(sub 4) and c=3.04(sub 5)A. Reactions between Ti₂O₃ and Ta₂O₅ under the same conditions result in the formation of Ti_{0.6}Ta_{0.42} a solid solution between TiTaO₄ and TiO₂. Solid solutions of VTaO₄ with AlTaO₄ and CrTaO₄ have been prepared. A linear relationship was observed between the ionic radii of the trivalent ion in the tantalates having the rutile structure and their lattice parameter. (Auth)

<318>
Penimore, J.W., and J.H. Horton, Jr., Influence of High Level Waste Salts on Movement of Strontium and Cesium in Savannah River Plant Soil. 1968, January. DP-1124; 22 p. (Savannah River Laboratory, Aiken, SC)

The presence of salts from high level radioactive waste reduced leaching of Sr 90 and Cs 137 in laboratory columns of sandy clay soil by groundwater and by 0.1M solutions of Ca(NO₃)₂, HNO₃, and KNO₃. Waste salts decreased leaching rates by reducing the permeability of waste saturated zones and by increasing Cs 137 fixation by mica minerals. (Auth)

<319>
Ferri, E.S., and E.J. Baratta, Polonium 210 in Tobacco Products and Human Tissues. 1966, September. Radiological Health Data and Reports, 7, 485-488 (U.S. Public Health Service, Winchester, MA)

Using a smoking machine, tobacco smoke was collected. It was found that the Po 210 content of the tobacco smoke accounted for 11 to 30 percent of that found in the total product, depending on the type of filter used. Analyses of human tissues indicated that the lung, blood, and liver, in that order, of smokers contained more Po 210 than the corresponding organs of nonsmokers. (Auth)

<320>
Ferron-Trosseau, P., Cesium Absorption by Barley--Influence of its Retention by the Soil--Competitive Action of Potassium. 1965, May. CEA-R-2708; 64 p. (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France)

The effects of variations in cesium concentration and presence of potassium cations on cesium uptake by barley were investigated with various culture media. Cesium distribution in the soil and between the soil and solution was considered as a function of the quantity of Cs. Significant differences were noted in responses of the barley to nutritive solutions and to soils. In the nutritive solution, the fraction of Cs (radioactive and stable) absorbed by barley remained practically constant in the presence of increasing amounts of stable cesium. Whereas in soil, the fraction of the

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radioactive cesium absorbed, increased in relationship with a rapidly decreasing selectivity of the soil for cesium anions. The difference between the results is thus explained by the very pronounced selectivity of the soil studied for Cs anions as long as the proportion of Cs remains low, close to that of other soils. Addition of potassium to a culture medium already rich in this element did not reduce the absorption of cesium by barley. Thus, radiocesium incorporated without carrier into a soil of medium exchange presented relatively little danger because of the close interdependence of radiocesium uptake by plants and its retention in the soil. (NSA)

<321>

Fiedler, Von, H.J., and H. Reissig, Die Kontamination von Boden und Pflanzen mit Strontium 90 als Folge der Kernwaffentests im Zeitraum 1960-1963. 1965. Biol. Rundsch., 3(4), 149-168 (Technische Universität, Institute für Bodenkunde und Standortlehre Dresden, German Democratic Republic)

Fallout data of Strontium 90 in soils and plants over Germany is compared to other regions of the world. (CWF)

<322>

Findenegg, G., and E. Broda, Mechanism of Uptake of Trace Elements by Plant Roots. 1965. Nature, 208, 156-157 (University of Vienna, Institute of Physical Chemistry, Vienna, Austria)

Experimental data indicate that the accumulation of zinc in plants was a result of passive rather than active processes. (CWF)

<323>

Finkelstein, N.P., R. Lombard, V.M. Lovell, and S.A. Allison, The Adsorption of Uranyl Species on Pyrophyllite, Quartz, and Acid-Treated South African Uranium Ores, A Preliminary Investigation. 1971. NIM-1205; 21 p. (National Institute for Metallurgy, Johannesburg, South Africa)

A brief investigation of the adsorption of ionic species of uranium by pyrophyllite and quartz was made. A more detailed study of the adsorption and desorption of uranyl species (from sulphate solution) by ore from the Rossing deposit was also undertaken. Owing to poor reproducibility, the interpretation of the results was difficult. However, it was found that complete desorption of the uranium occurs after adsorption from solutions containing 8.5 ppm of uranium. Adsorption of uranyl species by Buffelsfontein ore was also investigated. It was concluded that the amounts of uranium that might be lost due to adsorption in the extraction process were probably very small, amounting to less than 0.6 per cent of the head value of the uranium. (Auth)

<324>

Fisenne, I.M., Distribution of Lead 210 and Radium 226 in Soil. UCRL-18140; Part of Proceedings of the 13th Meeting on Bioassay and Analytical Chemistry held in Berkeley, California, (p. 145-158) (New York Operations Office (AEC), NY)

The Ra 226 and Pb 210 content of typical tobacco-growing soil was studied as a function of depth. The depth profile samples, including surface vegetation, were collected

at an undisturbed area in Maryland. It was of interest to determine whether these nuclides concentrate in the upper horizons of this soil type. Pb 210 generally decreased with increasing depth, resulting in a decrease in the Pb 210/Ra 226 ratio. An attempt was made to correlate this trend with the known radon emanation rates from soil. (Auth)

<325>

Fisher, H.L., J.R. Coleman, and R.D. Grundy, Strontium 90 Concentrations Observed in United States Pasteurized Milk Compared with Strontium 90 Levels in Precipitation, in Total Deposition, and in Soil, 1960-1963. 1966. Radiological Health Data and Reports, 7, 427-439 (Public Health Service, Radiation Surveillance Center, Washington, DC)

Annual averages of strontium 90 concentrations in milk were compared with precipitation, strontium 90 deposition, and strontium 90 in soil for the years 1960-1963 on the basis of linear relationship. Although it was clear that increased deposition of strontium 90 was related to its concentration in milk, variations in the relationship remain to be studied on the basis of the specific transport mechanisms involved. (Auth) (CWF)

<326>

Flaig, W., E. Kuster, K. Haider, G. Beutelspacher, Z. Filip, and J.P. Martin, Influence of Clay Minerals on the Formation of Humic Substances by some Soil Fungi. 1971. Soviet Soil Science, 3, 322-330 (Institute of Soil Biochemistry, Bransschweig, German Federal Republic; Institute of Agricultural Microbiology, Giessen, German Federal Republic; Agricultural Institute of Prague, Prague, Czechoslovakia)

The influence of montmorillonite, kaolinite, and finely ground quartz on the formation of humic-acid type polymers by EPICOCCUM NIGRUM and STACHYBOTRYS CHARTARUM was studied. The fungi were grown in stationary cultures and during shaking. In most cases, clay minerals and quartz accelerated and enhanced biomass formation, glucose consumption, incorporation of N into cells, and the efficiency of glucose utilization for cell synthesis. In general, clay minerals reduced the time required for the formation of dark-colored substances in the culture solutions. The ratio of the total humic acid to the total cell substance or the glucose consumed was also usually increased by montmorillonite. Humic-acid polymers were formed in cells before they were noticed in solutions. The clay did not appreciably alter the chemical properties of the humic polymers. The observations show that by affecting growth and metabolism, the clays indirectly influence phenolic polymer formation. (Auth)

<327>

Fletcher, W., W.J. Gibbs, J.R. Moroney, D.J. Stevens, and E.W. Titterton, Strontium 90 in the Australian Environment During 1966. 1968. Australian Journal of Science, 30, 307-313 (Australia Atomic Energy Authority, Laboratories Division, Capenhurst Works, Australia; Commonwealth Bureau of Meteorology, Atomic Weapons Tests Safety Committee, Australia; Commonwealth Department of Supply, Atomic Weapons Tests Safety Committee, Australia; Commonwealth X-Ray and Radium Laboratory, Atomic Weapons Tests Safety Committee, Australia; Australian National University, Research School of Physical Sciences, Department of Nuclear Physics, Atomic Weapons Tests Safety Committee, Australia)

During 1966 measurements were made of the Sr

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90 content in precipitation soils, liquid milk, flow, and human bone tissue at eight monitoring stations throughout Australia. From these measurements, the mean deposition of Sr 90 was determined to be about 1 mCi/km²/yr. These results are tabulated and compared with data from preceding years. (NSA)

<328>

Flocker, W.J., and W.H. Fuller, Availability of Calcium in Calcareous Soils. 1956. Soil Science Society of America Proceedings, 20, 387-392 (University of Arizona, Agricultural Experiment Station, Tucson, AZ)

Ten Arizona soils ranging in calcium carbonate content from 0 to 13 percent were collected and tested under greenhouse conditions for available calcium using soluble radiocalcium and radiostrontium salts for A value measurements. Neither the total amount of radioelement absorbed nor the percentage of radioelement in the plant derived from the added source was found to be related to the soil calcium soluble in water or 1:1 HCl, the calcium carbonate content or "active" calcium as measured by the Drouineau method. Further study showed that plants took up more soil calcium from acid soils of the humid Midwest than from some calcareous soils of Arizona. The amount of exchangeable calcium in soils was significantly correlated with the amount of available calcium in soils. Calcium carbonate was found to be very poorly available to plants regardless of its source. (Auth)

<329>

Flynn, W.W., The Determination of Strontium 90 in Environmental and Biological Materials using Di-(2-Ethylhexyl) Phosphoric Acid. 1967, December. AEC/TM-421; 18 p. (Australia Atomic Energy Commission Research Establishment, Lucas Heights, Australian)

A method is described in which strontium 90 is determined by solvent extraction of the yttrium 90 daughter. After a preliminary extraction of a hydrochloric acid solution of the sample by bis(2-ethylhexyl) phosphate, yttrium 90 is allowed to return to equilibrium in the presence of yttrium carrier. A second extraction quantitatively separates the yttrium 90 which is subsequently stripped into concentrated hydrochloric acid. An extraction with Aliquat 336 is used to remove interfering radionuclides before the yttrium is finally precipitated and counted as the oxalate. Typical recovery is 85 to 90 percent. (Auth)

<330>

Fontaine, G., Ground Disposal Methods for Radioactive Solid Wastes at the Ispra Establishment of Euratom. 1967. CONF-670512. STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 109-121) (Euratom, Ispra, Italy)

Radioactive solid waste produced in the reactors and laboratories of the Ispra establishment of Euratom can be divided into highly contaminated but nonactivated waste (waste from laboratories, hot cell decontamination, etc.), and highly activated but lightly contaminated waste (waste from in-pile loops and experiments). Ground disposal methods are used only if there is no material in the waste which can react with the cement. Various methods have been considered

and utilized, underground wells being utilized in each case. A study of construction cost revealed an economical solution with respect to high-level activity and security, which also covers direct irradiation and the eventual transfer of contaminations. (Auth)

<331>

Fowler, E.B., J.R. Buchholz, C.W. Christenson, W.H. Adams, and E.E. Rodriguez, Soils and Plants as Indicators of the Effectiveness of a Gross Decontamination Procedure. 1971. LA-DC-9544; CONF-680507; Part of Proceedings of a Conference on Radiological Protection of the Public in Nuclear Mass Disasters held in Interlaken, Switzerland, May 27-June 1, 1968, (p. 456-459) (Los Alamos Scientific Laboratory, Los Alamos, NM; Junta de Energia Nuclear, Division de Medicina y Protection, Madrid 3, Spain)

The results of an investigation on the soil-plant relationship which was initiated to obtain data relative to plutonium concentrations in the soil and possible resulting concentrations of plutonium in the plants grown on those soils are presented. (NSA)

<332>

Fowler, E.B., and C.W. Christenson, Effect of Soil Nutrients on Plant Uptake of Fallout. 1959. Science, 130, 1689-1693 (Los Alamos Scientific Laboratory, Los Alamos, NM)

Large field tanks, 5 by 5 feet and 2 feet deep, were used to evaluate the uptake of radio-strontium and cesium. They found the uptake of strontium was decreased on increasing application of calcium and the decrease appeared to be greater in lettuce and grass than alfalfa. Depth of feed by the plant was found to be a important factor in the adsorption on radionuclides from the soil. (CONF)

<333>

Francis, C.W., Plutonium Mobility in Soil and Uptake in Plants: A Review. 1972. Journal of Environmental Quality, 12 p. (Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN)

Based on the general inability of heavy metals to be translocated within plants and the past work on plutonium mobility in soil and its uptake by plants, the most likely mode of plutonium entry into food chains leading to man would be that chelated with naturally occurring organic soil components. Chelation mechanisms have not been established. Probably one of the reasons they remain unconfirmed is that much of the past research has involved short-term greenhouse experiments and studies using soils low in organic matter developed under arid or semiarid conditions. Mobility of plutonium after deposition on the surface of rich prairie or forested soil developed in a temperate to subhumid or humid climate is presently unknown. (Auth)

<334>

Francis, C.W., Source of Polonium 210 in Plants. 1967. Ph.D. Thesis; 83 p. (University of Wisconsin, Madison, WI)

This investigation was initiated to determine the Po 210 content of plant materials, soils and rainwater to establish the source and mode of entry of Po 210 into plants. Two basic methods were used to isolate Po 210 from soil

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and plant tissue, namely, the digestion of the plant tissue or soil sample with concentrated HCl and the oxidation of plant tissue samples with a mixture of concentrated H₂SO₄, 60 percent HClO₄, and concentrated HNO₃ or a decomposition of soil samples with a mixture of concentrated H₂SO₄, 60 percent HClO₄ and 48 percent HF. Because Po 210 is the only alpha emitter that spontaneously deposits electrochemically on Ag in dilute HCl, Po 210 was isolated from the digestate by plating on Ag disks; the alpha-activity was determined by a semiconductor solid state detector. The recovery, by the concentrated HCl digestion method, of Po 210 added to plant tissue samples averaged 78 percent with a standard deviation of plus or minus 17 percent. Average recovery by the wet ashing procedure (H₂SO₄-HClO₄-HNO₃) was 102 plus or minus 10 percent. Thus, the concentrated HCl provided insufficient digestion for isolation of Po 210 from plant tissue, even though it has been used extensively in the past. Similarly concentrated HCl digestion of soil samples gave lower recoveries of Po 210 than the decomposition method (H₂SO₄-HClO₄-HF). By the H₂SO₄-HClO₄-HF decomposition technique, recovery of Po 210 added to a variety of soil samples was 100 plus or minus 3 percent; HCl digestion gave 60 to 91 percent of the Po 210 contents obtained by H₂SO₄-HClO₄-HF decomposition. Determination of Po 210 contents at intervals of three months over a one year period showed that radioactive ingrowth of Po 210 occurred in stored tobacco leaves. The increase in Po 210 content during storage showed Po 210 was derived from and therefore in radioactive equilibrium with Pb 210. Extrapolation of rate of ingrowth curves obtained by a modified Bateman equation established that Po 210 entered the plant before curing and during the growing season. Because the Po 210 content of greenhouse cured tobacco leaves sealed in glass jars after harvest and air drying were similar, it was concluded that Pb 210 did not enter the tobacco leaves during the curing process. A number of experiments were designed to evaluate the mechanism of Po 210 entry into plants as follows: measurement of Po 210 uptake by plants in nutrient culture, comparison of the Po 210 contents of leaf tissue grown in greenhouse soil culture with leaf tissue grown under field conditions and exposed to natural radioactive fallout, and measurement of Po 210 contents of rainwater. Five kinds of evidence are presented showing that Po 210 or Pb 210 does not enter plants by direct uptake from the soil; Po 210 from nutrient solutions is not translocated readily to the aerial portions of the plant, no detectable quantities of Po 210 were found in the center of dead cabbage heads left in the field over winter while the outer leaves contained as much as 5.4 pCi/g, common extracting solutions used to evaluate available forms of many mineral elements in soils failed to extract detectable amounts of Po 210, after sufficient time for ingrowth, no detectable quantities of Po 210 were found in greenhouse cultured corn, tobacco, ryegrass, and peas while appreciable quantities (0.56 to 1.65 pCi/g) were found in the leaf tissue of field grown crops, adequate amounts of Po 210 were found in rainfall for all Po 210 in field grown crops. The rate of ingrowth of Po 210 in rainwater collected during the summer of 1966 was determined. Aliquots of rainwater were subdivided into two fractions; dust particles retained on a 0.22 μ Millipore filter, and the filtrate containing particulate matter < 0.22 μ in diameter. Ingrowth of Po 210 in the filtrate fraction was observed but the Po 210 and Pb 210 in the

dust fraction > 0.22 μ were in steady state equilibrium. From calculation of the rate of Po 210 ingrowth in the filtrate fraction the mean residence time of Pb 210 in the troposphere was calculated to be approximately eight days. The distribution of Po 210 in virgin soil profiles indicated that Po 210 or its immediate precursors are not readily leached. In addition, oxidation and iron oxide removal treatments on intact soils and soil separates, clay, silt and sand, showed that Po 210 is very immobile in soil systems and is likely irreversibly sorbed on clay and organic colloids. (Auth)

<335>

Francis, C.W., and G. Chesters, Radioactive Ingrowth of Polonium 210 in Tobacco Plants. 1967. J. Agr. Food Chem., 15, 704-706 (University of Wisconsin, Madison, WI)

Polonium 210 is an beta-emitting radioelement found in tobacco and thought to be a possible initiator of bronchial cancer in cigarette smokers. An investigation was initiated to evaluate the extent of Po 210(84) ingrowth in tobacco and to determine the possible existence of an equilibrium between Pb 210(82) and Po 210(84). The Po 210(84) content of cured tobacco leaves was determined at intervals of three months for one yr. Increasing concentrations of Po 210(84) were found after storage, thereby proving the existence of Po 210(84) ingrowth from some radioactive precursor. To determine the precursor responsible, it was necessary to consider the decay chain of U 238(92) and establish criteria for the existence of an equilibrium between Po 210(84) and Pb 210(82). The Po 210(84) in leaves of tobacco was shown to be derived from and in radioactive equilibrium with Pb 210(82). Linear extrapolations of Po 210(84) ingrowth obtained by a modified Bateman equation indicated that Pb 210(82) entered the tobacco leaves during the growing season either by plant uptake or by deposition in natural radioactive fallout. (NSA)

<336>

Francis, C.W., G. Chesters, and W.H. Erhardt, Polonium 210 Entry into Plants. 1968, September. Environ. Sci. Technol., 2, 690-695 (University of Wisconsin, Madison, WI)

The possibility that root uptake of Pb 210 from soils is the principal mechanism of Po 210 entry into plants was evaluated and proved to be invalid. If the Pb 210 in the plant is not soil-derived, the second most likely source is natural radioactive fallout, of which the most important component is from rainfall. Material balances of the quantities of Pb 210 in tobacco over time intervals of known rainfall indicate rains deposit approximately twice as much Pb 210 as observed in tobacco leaves, verifying the hypothesis that deposition of Pb 210 by rainfall is the principal mechanism of Po 210 entry in plants. (Auth)

<337>

Franklin, R.E., P.L. Gersper, and M. Holowaychuk, Analysis of Gamma-Ray Spectra from Soils and Plants. II. Effect of Trees on the Distribution of Fallout. 1967, January-February. COO-414-2; Soil Science Society America Proceedings, 31, 43-45 (Ohio Agricultural Research and Development Center, Wooster, OH; Ohio State University, Columbus, OH)

The distribution of fallout in soil from a

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forested area was studied. Surface soil samples (0 to 7.5 cm) collected at several distances from the stems of beech (FAGUS GRANDIFOLIA), sugar maple (ACER SACCHARUM), tulip (LIRIODENDRON TULIPFERA), scarlet oak (QUERCUS COCCINEA), hickory (CARYA GLABRA), and white oak (QUERCUS ALBA) trees were analyzed by gamma-ray spectroscopy. The concentration of Cs 137 in the soil near the stem of a beech tree was about five times higher than at other positions under the canopy. This effect was about one-half as great for sugar maple and much less for the other species. The magnitude of this concentration is apparently related to the quantity of stem-flow water, which may be appreciable with some species and negligible with others. Samples collected at four depth intervals (0 to 7.5, 7.5 to 15, 15 to 22.5 and 22.5 to 30 cm), in an area which included three of the trees, were also analyzed. (Auth)

<338>

Franklin, R.E., P.L. Gersper, N. Holowaychuk, and M. Elfield, Distribution of Gamma Emitting Isotopes in Soils as Influenced by Trees. 1965. TID-22443; (p. 55-82) (Ohio Agricultural Research and Development Center, Wooster, OH)

An analytical method was developed for measuring small amounts of gamma ray emitting isotopes in soil and plant samples. Cesium 137 concentrations in the surface soil was about 4 times higher within 1 foot of the stem of a FAGUS GRANDIFOLIA than at distances greater than 5 feet away. This concentrating effect near the stem appeared to be correlated with smoothness of bark and stem flow. There was appreciable downward movement of the fission products in the soil near the stem. Near the stem as much as 15 percent of the Cs 137 in the 0-12 inch layer soil reached a depth of 6 to 9 inches, while only 1 percent reached this depth at positions further from the stem. (NSA) (CWF)

<339>

Fredriksson, L., Studies on Plant Accumulation of Fission Products Under Swedish Conditions. VI. A New Experimental Technique for Studies of Plant Absorption of Nutrients and Fission Products Under Field Conditions.. 1963. FOA-4-4323; 18 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

A new experimental technique for studies of plant absorption of nutrients and fission products from soils under field conditions has been designed. The technique is described and its merits in comparison with the conventional pot and field and experiment techniques are discussed. (Auth)

<340>

Fredriksson, L., Plant Uptake of Fission Products. III. Uptake of Cesium 137 by TRIFOLIUM PRATENSE as Influenced by the Potassium and Calcium Level in the Soil. 1970. Lantbrukshogskolans Annaler, 36, 41-60 (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

Plant uptake of cesium 137 was carried out on a large number of soils in which the potassium content had been characterized. Regression analyses showed a very pronounced inverse relationship between the content of exchangeable soil potassium and plant uptake of Cs 137. (CWF)

<341>

Fredriksson, L., Plant Uptake of Fission Products. IV. Uptake of Strontium 90 and Cesium 137 from Tropical Soils and Subtropical Soils. 1970. Lantbrukshogskolans Annaler, 36, 68-89 (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The uptake of strontium 90 and cesium 137 was measured in plants grown under greenhouse conditions at various rates of lime, calcium, and potassium amendments. Liming was found to be an effective method in depressing the uptake of radiostromtium. The liming effect was thought to result from dilution of radiostromtium with calcium on the soil exchange sites as well as increasing the number of soil exchange sites as the pH is raised. Because the quantity of micaeous minerals in the lateritic soils is much smaller than in temperate zone soils the fraction of Cs 137 absorbed from the soils by plants is much greater in the tropical soils. Potassium applications to the lateritic soils generally decreased plant uptake of Cs 137 substantially. (CWF)

<342>

Fredriksson, L., Studies on Plant Accumulation of Fission Products Under Swedish Conditions. V. Uptake by Pasture and Ley Plants of Strontium 90 and Cesium 137 in Swedish Field Experiments. 1963. FOA-4-4322; 16 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

Absorption of Sr 90 and Cs 137 by pasture plants has been studied in field experiments. The fission products were applied to two different types of grazing land by spraying in early spring before the vegetation had started growing. The influence of different lime and fertilizer treatments on plant absorption of the radionuclides was also studied. (Auth)

<343>

Fredriksson, L., and A. Eriksson, Studies on Plant Accumulation of Fission Products under Swedish Conditions. VII. Plant Absorption of Strontium 90 and Cesium 137 from Soil as Influenced by Soil Organic Matter. 1966, July. FOA-4-4485-4623; 25 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The influence of soil organic matter on the mobility and plant availability of Sr 90 and Cs 137 has been studied in laboratory and pot experiments. A field survey of the content of Cs 137 in hay from soils differing in content of organic matter has also been performed. It was found that the mobility and plant availability of Sr 90 was only slightly influenced by the content of organic matter in the soil. The most important soil factor influencing plant uptake of Sr 90 was found to be the content of exchangeable calcium. Plant uptake of Cs 137 is, however, very dependent on the content of organic matter in the soil as it increases with increasing content of such matter. Two other factors of major importance for plant absorption of Cs 137 are the content of clay and potassium. Increasing content of K sub HCL (or micaeous clay) means increased adsorption of Cs 137 in the soil and thus lowered plant availability. As K and Cs exert antagonistic effects on each other when sorbed by the plants, increased content of very soluble K in the soil also depressed plant absorption of Cs 137. The overall results of the investigation show that under the conditions prevailing in Sweden in the summer of 1963 from 3 to 25% depending on soil

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type of the Cs 137 found in hay originated from deposits in the soil while from 75 to 97% was collected by direct uptake or adsorption from the atmosphere. It is estimated that from 15 to 30% of the amount of Cs 137 deposited as fallout during the time period April-June was retained by ley vegetation rich in grasses. (Auth)

<344>

Fredriksson, L., and A. Eriksson, Plant Uptake of Fission Products. I. Uptake of Strontium 90 in Pot Experiments in Relation to Uptake Under Field Conditions. 1970. *Lantbrukshögskolans Annaler*, 36, 3-18 (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

Strontium 90 uptake was determined in a number of agronomic and horticultural plants in pot experiments from four Swedish soils differing in various properties. The dominant soil properties affecting the uptake of strontium 90 was found to be content of exchangeable calcium, degree of calcium base saturation and total base exchange capacity. (CWF)

<345>

Fredriksson, L., and A. Eriksson, Cesium 137 in Vegetation and Milk at the Experimental Farms of the Swedish Agricultural College in 1963. 1966, July. FOA-4-4484; 38 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

During the vegetation period in 1963 the content of Cs 137 and K was determined in the main crops grown for cattle feed on seven different experimental farms belonging to the Swedish Agricultural College. At the same time the content of Cs 137 in the milk produced at the farms was ascertained. The results of these measurements are reported and discussed with special reference to the prevailing fallout situation. (Auth)

<346>

Fredriksson, L., and A. Eriksson, Expected Content of Strontium 90 and Cesium 137 in Swedish Crops and Milk at a Total Deposition in the Plowlayer of 1 Curie Strontium 90 and 1 Curie Cesium 137 per Square Kilometer. 1968, May. FOA-4-4354-28; 18 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The contents of Sr 90 and Cs 137 that can be expected in certain crops and in milk in Sweden are calculated. The calculations are made for plant uptake from soil contaminated by 1 Ci of each nuclide per km². The calculations are based on actual contents of the nuclides in vegetation and milk in Sweden and on results from extensive tracer studies. (NSA)

<347>

Fredriksson, L., and A. Eriksson, Studies on the Transport of Fission Products through Food Chains. I. Cesium 137 in Vegetation and Milk at the Experimental Farms of the Swedish Agricultural College in 1963. 1966, July. FOA-4-A-4485-4623; 38 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

During the vegetation period in 1963 the content of Cs 137 and K was determined in the main crops grown for cattle feed on seven different experimental farms belonging to the Swedish Agricultural College. At the same time the content of Cs 137 in the milk

produced at the farms was ascertained. The results of these measurements are reported and discussed with special reference to the prevailing fallout situation. (Auth)

<348>

Fredriksson, L., A. Eriksson, E. Haak, O. Soederman, and H.A. Auraldsson, Studies on the Transport of Fission Products through Food Chains. II. Cesium 137 in Swedish Grain Crops, 1962-1967. 1970, August. FOA-4-4435; 31 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

During 1962 to 1967, the Cs 137 content of about 1700 representative samples of Swedish cereals was determined. The cesium content of the grain reached its peak mean value, 875 pCi Cs 137 per kg in 1963. Thereafter, the contamination decreased roughly by one-half every year. Rye had about 70 percent higher Cs content than the other cereals. Regional differences in the contamination level of the cereals were found. These could be explained by differences in the amount of fallout and its distribution in time during the vegetation period combined with regional differences in crop development as related to seasonal changes of the fallout rate. (Auth)

<349>

Fredriksson, L., A. Eriksson, and E. Haak, Plant Uptake of Fission Products. II. Uptake of Strontium 90 by TRIFOLIUM as Influenced by the Calcium and Phosphate Status in the Soil. 1970. *Lantbrukshögskolans Annaler*, 36, 19-39 (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The uptake of radiostrontium from a large number of Swedish soils showed that the main factor influencing the accumulation of radiostrontium in the plants by root uptake was the content of exchangeable calcium in the soil. Regression analyses are given showing the contribution of soil properties on uptake of radiostrontium in diploid red clover, TRIFOLIUM PRATENSE. (CWF)

<350>

Fredriksson, L., A. Eriksson, and H. Lonsjö, Studies on Plant Accumulation of Fission Products Under Swedish Conditions. VIII. Uptake of Cesium 137 in Agricultural Crops as Influenced by Soil Characteristics, and Rate of Potassium Fertilization in a Three Year Micro Plot Experiment. 1966, July. FOA-4486-4623; 20 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

An extensive micro plot experiment has been performed to study plant uptake of Cs 137 under field conditions from three different soils at three different rates of potassium fertilization during a three year crop rotation with oats, peas, and white mustard. The plant uptake of Cs 137 was found to decrease very substantially with increased content of clay and with an increased rate of potassium fertilization. The crops differed in Cs 137 uptake in the following order: oats less than white mustard less than peas. The Cs 137 uptake varied in the experiment with soil type, plant species, and treatment within a range as large as 1-47. On the basis of the experimental results the relative plant uptake of Cs 137 from the soil under fallout conditions is assessed. (Auth)

<351>

Fredriksson, L., A. Eriksson, H. Lonsjö, and E.

<351> CONT.

Haak, Migration and Plant Availability of Fission Products in a Lysimeter Experiment. I. Plant Uptake and Leaching of Cesium 137. 1968. FOA-4-A-4357-28; 26p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

Results are reported from the first three years in a lysimeter experiment about plant absorption and leaching of Cs 137 added to different soils at the start of the experiment. It was found that plant uptake of Cs 137 was influenced much more by the conditions in the upper 25 cm of the soil profile than by deeper layers. Application of complete fertilizers containing ammonium nitrogen enhanced plant absorption of Cs 137 with the drainage water varied inversely with crop yield. The content of Cs 137 in the drainage water was lower from pots where the subsoil was fine sand than from those where the subsoil was clay. The difference is explained by the more intense interaction between water and soil when the water passed through the homogenous sandy subsoil than when it passed through cracks, etc. in the clay. (Auth) (CWF)

<352>

Fredriksson, L., A. Eriksson, E. Rasmussen, B. Gahne, K. Edvarsson, and K. Low, Studies on Soil-Plant-Animal Interrelationships with Respect to Fission Products. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 449-470), 624p. (Royal Agricultural College Department of Radiobiology, Uppsala, Sweden; Research Institute of National Defense, Stockholm, Sweden)

The uptake of strontium and cesium from soils was measured under different levels of calcium and potassium, respectively. Movement of strontium cesium, rubidium and cerium was monitored through a soil profile. The strontium uptake data in plants was expressed in terms of OR values. (CWF)

<353>

Fredriksson, L., E. Haak, and A. Eriksson, Studies on Plant Accumulation of Fission Products under Swedish Conditions. IX. Plant Uptake of Strontium 90 and Calcium 45 as Influenced by Soil Chemical Properties. 1968, December. FOA-4-4378; 30 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The influence of different soil factors on the uptake of Sr 90 and Ca 45 by red clover was studied in pot experiments with 169 soils. With the aid of multiple regression analysis, functional relationships between the factors studied were established. The relationships found may be used for quantitative assessments of plant absorption of Sr 90 through uptake under various soil conditions. (Auth)

<354>

Fredriksson, L., E. Haak, and A. Eriksson, Studies on Plant Accumulation of Fission Products under Swedish Conditions. XI. Uptake of Strontium 90 by Different Crops as Influenced by Liming and Soil Tillage Operations. 1969, July. FOA-4-4395; 57 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The effect and practical value under Swedish conditions of lime and various soil tillage operations to reduce the transport of strontium 90 from the soil through foodchains

to man after heavy fallout were investigated in four micro plot field experiments carried on for seven years. In the experiments the effect of different soil management practices were simulated by placing strontium 90 at different depths in the soil profile. In two of the experiments the placement effect was studied at two levels of pH and base saturation. The placement effect was evident. The deeper strontium 90 was placed, the lower was the uptake by plants. However, the effect was modified by a number of soil conditions, and climatic factors such as amount and distribution of precipitation. The effect of liming on the uptake of strontium 90 was high for Ca-deficient soils but low for soil rich in Ca. Plant availability of strontium 90 deposited in the soil did not show any gradual reduction during the seven-year-long experimental period. Practical value of different methods for decreasing plant uptake of strontium 90 is discussed. (NSA)

<355>

Fredriksson, L., H. Loensjoe, and A. Eriksson, Studies on Plant Accumulation of Fission Products under Swedish Conditions. X. Absorption of Strontium 90 and Cesium 137 from Soil by Vegetable Crops. 1969, March. FOA-4-4387; 31 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

Studies were carried out on the amount of strontium 90 and cesium 137 in a number of crops, representing leafy vegetables, root crops, cabbages, beans, and others, absorbed under field conditions from two different contaminated soils. It was found that shallow-rooted crops accumulated more of the nuclides than deep rooted crops in morphologically the same type of plant tissues. In relation to calcium a higher strontium 90 content was found in the roots than in the aerial parts of the plants analyzed. The strontium 90 content in edible parts of the crops decreased in the following order: spinach, lettuce > radishes > beans, carrots > beets, parsnips > cauliflower, cabbage > potatoes. The cesium 137 content decreased in the following order: lettuce, spinach, cauliflower > radish, cabbage, carrots > parsnips, beans > beets, potatoes. (Auth)

<356>

Fredriksson, L., H. Loensjoe, and A. Eriksson, Studies on Plant Accumulation of Fission Products under Swedish Conditions. XII. Uptake of Cesium 137 by Barley and Peas from Twelve Different Top Soils Combined with Two Subsoils in a Long-Term Micro-Plot Experiment. 1969, November. FOA-4-4405; 45 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

In a long-term microplot experiment, uptake of cesium 137 by barley and peas from twelve Swedish arable soils on two different subsoil types was studied. The uptake of cesium 137 in the crops was largely dependent on the content of clay and organic matter in the soil. Decreasing content of clay and increasing content of organic matter in the soil both enhanced the cesium 137 uptake in the crops. Therefore, the cesium 137 content in barley seed varied between 10 and 150 pCi per kg dry matter at a deposition in the soil of 1 Ci cesium 137 per sq.km. The cesium 137 content in peas was about 5 times higher. The experiments also showed that on subsoils easily accessible to the plant roots the uptake of cesium 137 from the plough layer soil may be about one third less than on subsoils less accessible to plant roots. When

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more potassium was taken away with the crops than was added by fertilizers, the cesium 137 uptake increased from year to year although the trend was occasionally influenced by the annual variations in the weather conditions, which caused variations in the root activity at different depths in the soil profile. (Auth)

<357>

Frere, M.H., The Solubility of Some Strontium Phosphates. 1962. Soil Science Society of America Proceedings, 26, 48-51 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Beltsville, MD)

Strontium phosphate precipitates were formed by mixing different amounts of $\text{Sr}(\text{OH})_2$ and H_3PO_4 . A solubility diagram was prepared from the analysis of the supernatant in equilibrium with the precipitate. X-ray diffraction patterns indicated that there were two compounds, SrHPO_4 and $\text{Sr}10(\text{PO})_6(\text{OH})_2$. From the solubility diagram, it is estimated that the K_{sp} of SrHPO_4 is 4.2×10^{-7} . The observed slope of the hydroxyapatite line was different than the theoretical line and it was postulated that change in slope is due to the different solubilities of different sized crystals. Calculations show that size differences between crystals sufficient to give the observed solubility differences could be too small to be detected by an electron microscope. (Auth)

<358>

Frere, M.H., and D.F. Champion, Characterization of Fixed Strontium in Sesquioxide Gel-Kaolinite Clay Systems. 1967. Soil Science Society of America Proceedings, 31, 188-191 (U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD)

Fixed Sr is defined by the amount of radioactive Sr remaining with the solid phase after three extractions with 1N $\text{Sr}(\text{NO}_3)_2$. The amount of Sr fixed in a soil-water suspension increases with time in a manner characteristic of a slow diffusion process. Experiments with Fe or Al gel-kaolinite clay suspensions showed a similar behavior. The amount of fixation in gel-clay suspensions increased with pH to a level of about 6 percent of the adsorbed Sr at pH 8. Several exploratory experiments indicate a silicate interface may be important in the fixation mechanism. (Auth) (CWF)

<359>

Frere, M.H., R.G. Menzel, K.H. Larson, R. Overstreet, and R.F. Reitenauer, The Behavior of Radioactive Fallout in Soils and Plants. 1963. National Academy of Sciences-National Research Council Publication 1092 (U.S. Department of Agriculture, Soils Laboratory, Beltsville, MD; University of California, Los Angeles, CA; University of California, Berkeley, CA; U.S. Atomic Energy Commission, Washington, DC)

A review was written for the National Academy of Sciences evaluating the possible exposure problems resulting from radioactive fallout. (CWF)

<360>

Frere, M.H., R.G. Menzel, H. Roberts, Jr., D.L. Myhre, M. Amemiya, O.W. Beale, D.R. Timmons, and E.H. Wood, Reduction in the Plant Uptake of Strontium 90 by Soil Management Treatments. 1967. Technical Bulletin No. 1378, 38 p. (U.S.

Department of Agriculture, Agricultural Research Service, Beltsville, MD)

The burial of Sr 90 deeper in the soil profile reduced the Sr 90 content of corn and soybean grain at most about 60 percent and of oat and wheat grain about 20 percent. There was much variability among locations and crops. The magnitude of the measured reduction is less than the true value, because some fallout was deposited on the plant during the growing season. In addition, the value for oats and wheat is low because fallout was deposited on the deep-placement plots during the previous year. Irrigation, calcium, and potassium additions did not enhance the reduction by deep placement, although the calcium addition, alone, did cause a reduction of approximately 20 percent in the two Southern States. Fallout after the establishment of the deep-placement plots and during the growing season obscured any treatment effects with the grasses and legumes. No means were found to accurately assess the contribution of foliar deposition to the Sr 90 content of the plants. (Auth)

<361>

Frere, M.H., and H. Roberts, Jr., The Loss of Strontium from Small Cultivated Watersheds. 1963. Soil Science Society of America Proceedings, 27, 82-83 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Beltsville, MD)

Soil samples were taken from the plow layer of eight small watersheds and analyzed for strontium 90. Two watersheds in permanent pasture, with no recorded loss soil, contained about 90 mCi. per square mile, which is slightly higher than an estimated total deposit at the time of sampling. The plow layer of six watersheds under cultivation was sampled by compositing soil cores taken on contours of each watershed. The Sr 90 concentration of these samples was from one-third to two-thirds of that in the permanent pastures. The loss of Sr 90 appeared to be influenced by length of slope and cropping history. No areas of Sr 90 accumulation were found within these watersheds. (Auth)

<362>

Fried, H., Use of Isotopes in Agronomic Soil Science. 1971, February-April. Agrochimica, 15(2-3), 125-137 (International Atomic Energy Agency, Vienna, Austria)

The solid phase of the soil is the reservoir of most plant nutrients that must go through a series of reactions. Isotopes have proved to be ideally suited for studying this sequence of reactions at every stage and they are being widely used for this purpose. In addition, isotopes are being used increasingly in field experiments to make direct measurements of the uptake of nutrients from fertilizers by crop plants. More recently, advances in techniques have brought the costs of field experiments with N-15-labeled fertilizer to a reasonable level. This has resulted in a marked increase in the knowledge of the quantitative relationship between fertilizer supply and nutrient uptake under field conditions. (Auth)

<363>

Fried, H., H.E. Oberlander, and J.C. Woggle, Kinetics of Rubidium Absorption and Translocation by Barley. 1961. Plant Physiology, 36, 183-191 (U.S. Department of Agriculture, Agricultural

<363> CONT.

Research Service, Soil and Water Conservation
Research Division, Beltsville, MD)

Short time steady-state accumulation studies of radioactive rubidium by roots and shoots of 7-day-old barley plants indicate the relationship between active and passive processes in ion accumulation by shoots. If the carrier mechanism is used to describe the active process, the observed data are consistent with two competing active processes for an active intermediate, one leading to root accumulation and the other to accumulation in the shoot. The data are also consistent with two parallel active processes, one leading to root accumulation and the other to shoot accumulation. Shoot accumulation showed two concentration functions, one that predominated at high Rb concentration and another that predominated at lower Rb concentrations. These corresponded with the two concentration functions for Rb uptake by roots. Azide, methylene blue, DNP, potassium, and H ion were all shown to inhibit active rubidium accumulation but not always in the same way. The action of these inhibitors and the apparent dissociation constant, K_m , of the rubidium carrier combination were similar for roots and shoots. (Auth)

<364>

Prink, C.R., Fixation of Cesium 137 by Clay Soils, Final Report. 1971. NYO-2955-25; 18 p. (Connecticut Agricultural Experiment Station, New Haven, CT)

The effects of Cs sorption on the interlayer collapse in dioctahedral vermiculite in Connecticut soils were studied and compared with the collapse with di- and trioctahedral vermiculites obtained by successive removal of interlayer K from muscovite and biotite. The sorption and fixation of Cs by whole soils and how these characteristics are related to the mineralogy of the soils were investigated using Cs 137 tracers. It was concluded that the sorption and fixation characteristics of the whole soil can be predicted from the mineralogy of the clay fraction. (NSA)

<365>

Frissel, M.J., and P. Poelstra, A Theoretical Approach to the Movement of Strontium through Soils. 1964. Soil Science, 98, 274-277 (Euratom, Institute for Atomic Science in Agriculture, Wageningen, Netherlands)

A theory for the calculation of the leaching efficiency of soil for Sr 90 is presented. The difficulties of comparing the calculated and evaluated leaching efficiencies are discussed. Taking these difficulties into account, the order of magnitude of the values calculated is concluded to be quite satisfactory. The differences between theory and experiment increase in the order 0.005 M CaCl_2 , deionized water, 0.005 M NaCl. The great difference in leaching efficiency between 0.005 M CaCl_2 and 0.005 M NaCl is explained theoretically. (Auth)

<366>

Frissel, M.J., and P. Poelstra, Chromatographic Transport through Soils. I. Theoretical Evaluations. 1967. Plant and Soil, 26, 285-302 (Euratom, Wageningen, Netherlands)

An evaluation is given of the chromatographic theories that may be important for the soil. Special attention is paid to the assumptions that the various authors make in order to

enable a proper choice to be made of particular theory for a particular case. The relationship between the various theories is also stressed. (auth) (CWF)

<367>

Frissel, M.J., and P. Poelstra, Chromatographic Transport through Soils. II. Column Experiments with Strontium and Calcium Isotopes. 1967. Plant and Soil, 27, 20-32 (Euratom, Wageningen, Netherlands)

The rate of transport of Calcium and Strontium ions in resin-sand mixtures was measured at water fluxes ranging from 75 to 59440 cm per cm² per year, the distribution coefficient for these ions varying from 8 to 408. The rates measured agreed quite well with the calculated values. The dispersion pattern which developed during chromatographic transport was compared with some calculated dispersion patterns, the calculations being based on different theoretical approaches. In this way some assumptions concerning the general or partly general validity of these theories could be verified. There was good agreement between experiments executed on clay-sand and on resin-sand mixtures. (Auth)

<368>

Frissel, M.J., P. Poelstra, and P. Reiniger, Simulation of Strontium 90 Transport through Soils--Evaluation of Parameters. 1969, June 18. EUR-4294 (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen, Netherlands)

A model simulating the migration of Sr 90 in agricultural soils is presented. The alternatives considered are plowing or no plowing; continuous contamination or contamination occurring once only. Furthermore, many soil and climatic parameters of importance for the transport are also considered. Calculations on 72 combinations of parameters were performed. To make possible a general application of the results two coefficients were used: the Sr 90 leaching indicator and the mean apparent diffusion coefficient. Both coefficients can be calculated from soil and climatic characteristics. The results are presented in the form of 4 schemes and 42 figures. (Auth)

<369>

Frondel, C., Geochemical Scavenging of Strontium. 1958. Science, 128, 1623-1624 (Harvard University, Department of Mineralogy, Cambridge, MA)

Crandallite, an abundant mineral belonging to the alunite structure type, is a geochemical host for ordinary strontium in the soil profile and the deeper ground-water circulation. It may be useful in the scavenging or storage of the radioisotopes of strontium and certain other elements. (Auth)

<370>

Frost, J., and W.M. Sackett, Polonium Radioisotopes in Tobacco and the Atmosphere. 1967, June 1. COO-1540-5; 17 p. (University of Tulsa, Tulsa, OK)

Polonium 210, an alpha particle emitting radioisotope, is a natural contaminant in cigarette tobacco. Upon smoking a cigarette much of this Po 210 is transferred to the lung where it may cause types of bronchial cancer. People also ingest other polonium radioisotopes through breathing, that may

<370> CONT.

render the Po 210 from cigarettes negligible. In this paper the relative contributions from these two sources is examined. (Auth)

<371>

Fruh, E.G., and G.F. Lee, Sorption of Cesium on Stratified Mica. 1967. Part of Faust, S.D. and Hunter, J.V. (Eds.), Principles and Applications of Water Chemistry, (p. 168-216)

Sorption model of cesium on mica minerals is presented. (CWF)

<372>

Frysiner, G.R., and H.C. Thomas, The Ion-Exchange Behavior of Vermiculite-Biotite Mixtures. 1961. Soil Science, 91, 400-405 (University of North Carolina, Institute of Natural Science, Chapel Hill, NC)

Strontium and cesium sorption was investigated on vermiculite-biotite minerals. A strong fixation process was observed on addition of cesium to these minerals. (CWF)

<373>

Fuller, W.H., and W.J. Flocker, The Uptake of Radiostrontium by Certain Type Crops from Calcareous Soils. 1955. University of Arizona Technical Bulletin No. 130 (University of Arizona, Agricultural Experiment Station, Tucson, AZ)

A detailed report relating to the work done at the experimental station on uptake of radiostrontium from calcareous soils is given. Considerable work on available calcium is also reported. (CWF)

<374>

Fuller, W.H., and J.E. Hardcastle, The Uptake of Strontium by Various Type Crops and Factors Affecting Uptake and Translocation of Strontium and Calcium Native to Soil, Technical Progress Report. 1966. TID-23271; 36 p. (University of Arizona, Agricultural Experimental Station, Tucson, AZ)

This progress report presents current research work on three separate efforts: 1) delineation of relative absorption rates of strontium and calcium by certain algae, 2) characterization of inorganic and organic radiostrontium movement in soils, and 3) evaluation of calcium and strontium uptake by certain fungi. Results show that certain species of algae absorb calcium preferentially over strontium; however, certain species are able to absorb large amounts of strontium even though calcium needs of the organism are fulfilled. An enhancement in microbial activity slightly reduces radiostrontium movement as well as decreasing the extractable form in calcareous soils. Strontium does not appear to compete with calcium in fungi nutrition in nutrient cultures. (CWF)

<375>

Fuller, W.H., and J.E. Hardcastle, Relative Absorption of Strontium and Calcium by Certain Algae. 1967. Soil Science Society of America Proceedings, 31, 772-774 (University of Arizona, Agricultural Experiment Station, Department of Agriculture, Chemistry and Soils, Tucson, AZ)

The relative uptake of strontium and calcium was compared, using seven different species of algae isolated from fresh water and arid land. Uptake always favored calcium over strontium

when the two elements were present in nutrient media together. Strontium was absorbed in addition to the calcium requirement. With SCENEDEHUS Sp., however, strontium actually appeared to compete with calcium. (Auth)

<376>

Fuller, W.H., J.E. Hardcastle, R.J. Hannapel, and S. Bosma, Calcium 45 and Strontium 89 Movement in Soils and Uptake by Barley Plants as Affected by Calcium (Actinium) 2 and Strontium (Actinium) 2 Treatment of the Soil. 1966. Soil Science, 101, 472-484 (University of Arizona, Tucson, AZ)

Calcium and strontium acetate enhanced movement of radiostrontium in all six soils tested. The movement in the soils was inversely proportional to the cation-exchange capacity of the soils. (CWF)

<377>

Fuller, W.H., and E.P. L'Annunziata, Movement of Algal and Fungal-Bound Radiostrontium as Chelate Complexes in a Calcareous Soil. 1969, March. Soil Science, 107, 223-230 (University of Arizona, Tucson, AZ)

Leaching with a water-formaldehyde solution and water alone caused little movement of radiostrontium in Mohave sandy loam. Leachings with 0.067 M DTPA solutions displaced from 0.2 to 1.6 percent of the algal and fungal-bound radiostrontium below a 20-cm depth. The profile distribution of radiostrontium remaining in the leached soil columns was strikingly contrasted between the DTPA-treated and the H₂O-treated columns. Wherever DTPA was added, the radiostrontium moved downward throughout the column, whereas in the H₂O treated control soils, the radioactivity remained primarily in the upper 2.5 cm layer where it was applied. Evidence is given for the presence of negatively charged radiostrontium complexes formed from excretions of the desert soil alga ANACYSTIS MENEGER. (Auth)

<378>

Furnica, G., Retention of Certain Radioactive Ions by the Suspensions of Surface Basins and by Certain Active Earths in Rumania. 1970. CONF-690918-(Vol. 1); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 181-200), 684 p. (Institute of Hygiene, Bucharest, Rumania)

A study was made of the retention, by mud taken from the river of Dimbovitza-Bucharest, of the isotopes Na 22, Sr 85, Ag 110, Cs 134, Zn 55, Fe 59, and I 131 dissolved in the water. These isotopes are fixed by the mud in different proportions, i.e., 15 percent Na, 45 percent Sr, 37 percent I, 97 percent Zn, 95 percent Fe, or 58 percent Cs. By elution of the mud retaining Na 22, Sr 85, or Ag 110, a phenomenon of ion exchange between the radioactive ions and the natural product was observed. The sand fixes separately: 3.6 percent Na, 22 percent Ag, 72 percent Zn, 8.8 percent I, 99 percent Cs, 93 percent Sr, or 94 percent Fe. Treatment of the sand with 5 percent HNO₃ or 10 percent HCl alters the radioactive ion retention capacity. Similar determinations were made with montmorillonitic bentonites, the retention observed being greater with respect to Cs and smaller with respect to Na. (Auth)

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Furnica, G., and M. Toader, Polonium 210 Content

<379> CONT.

in Different Cigarette Blends. 1969. Iqiena, 18(8), 469-474 (Institute of Hygiene, Bucharest, Rumania)

Recent investigations supplied evidence of the presence of Po 210 in tobacco and cigarette smoke, and a higher content in the organisms of smokers. Po 210 was isolated radiochemically from various Rumanian cigarette blends and the content determined by measuring alpha activity in a methane gas counter. Results showed a variable Po 210 content, depending on the blend of the cigarette, and oscillating between 0.04 and 0.29 pCi/g, or 4×10 (E-18) to 3×10 (E-17) qPo/q tobacco. (Auth)

<380>

Gabay, J.J., J.A. Dapolito, J.C. Daly, and M.I. Sax, Uptake of Radioactivity by Vegetation - A Follow-Up Study. CONF-661018; Part of Proceedings of the 12th Annual Bioassay and Analytical Chemistry Meeting held in Gatlinburg, Tennessee, October 13-14, 1966, (p. 36-52) (New York State Department of Health, New York, NY)

Levels of activity in the crops, due to uptake, decreased with time with crops from the previously foliar-contaminated plots showing a significantly greater decrease. Again, crops grown on the non-fertile plots showed greater uptake than those grown on the fertile plots. However, several interesting deviations from the expected patterns have been noted throughout the experiment. (Auth) (CWF)

<381>

Gaglione, P., A. Malvicini, and L. Vido, Determination of Strontium 90 and Cesium 137 in Soil and Plants. 1960, June. Minerva Nucleare, 4, 155-161 (Comitato Nazionale per le Ricerche Nucleari, Ispra, Italy)

The methods for the extraction and chemical separation of Sr 90 and Cs 137 from the soil and plants are described. The values for the Sr 90 and Cs 137 contents of a number of soil samples collected near the Ispra Nuclear Research Centre and that of samples of plants collected monthly from May to September 1959 are presented. For a long vegetation period, the values for the Sr 90 discrimination factor from soil to plants are approximately 0.7. The values for the Cs 137 concentration found in the examined plants demonstrate a direct absorption of this nuclide from the air as well as its absorption from the soil through the roots. (Auth)

<382>

Gagnaire, J., and A. Chanel, The Use of Plants in the Control of Radioactive Pollution. 1963, March. Bull. Inform. Sci. Tech., 70, 39-44

The systematic measurement of the radioelement concentration in plant tissues, as well as the study of its variation with time, has become one of the most widely used methods for studying the variations in radioactive contamination of natural surroundings. The phytobiologists contribute to the development of a satisfactory technique by determining accurately the plant species which may be used, the radioelements to be dosed, the methods of extraction, separation, and dosage for the different radioelements, as well as the means of expressing and interpreting the results obtained. (Auth)

<383>

Gagnaire, J., A. Chanel, G. Perard, and B. Lachet, Study in Interpretation of the Variations of the Concentration Rates of Radioelements in the Black Poplar. 1967. AEC-tr-7040; Bull. Inform. Sci. Tech., 119, 27-37 (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Grenoble, France)

The black poplar is characteristic of the plant associations of river banks. The extent to which the climatic physiological, and chemical factors affect the localization and concentration of Ca 45, Sr 85, Ru 106, Cs 137, and Ce 144 in the poplar was studied. The variations in the rates of concentration of K 40 and Cs 137 in the leaves of poplars, willows, alders, and reeds were compared. The concentrations depend on the species and organ sampled and are related to the different stages of the vegetative cycle. Detection of atmospheric pollution owing to Cs 137, by measurement of the rates of Cs 137 concentration in the leaves, does not make it possible to do effective checking throughout the entire vegetative season. (Auth)

<384>

Gagnaire, J., A. Chanel, B. Lachet, and R. Magnaval, Distribution of a Mixture of Fission Products in a Small Model Simulating Ecological Conditions of a Stream. 1967, October. Bull. Inform. Sci. Tech., 119, 9-26 (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Grenoble, France)

A mixture of dissolved salts of Sr 85, Cs 137, Ce 144, was placed in a model made of freshwater and sediments only. The importance of the retention and the further salting out of the final equilibrium state is studied as also is the localization and concentration rate of radioelements in filamentous algae or in reeds that are growing in the same model. The disappearance of radioelements dissolved in the water is hastened by the presence of plants during the first weeks after the contamination with radioelements; but the ultimate balance between the radioelements in solid or liquid phase is not changed. (Auth)

<385>

Gailledreau, C., Une Remarque sur l'Effet des Matieres Organiques dans la Migration du Strontium 90 dans le Sol. 1960. Energie Nucleaire, 2, 287-289 (Commissariat a l'Energie Atomique, Service de Controle des Radiations et de Genie Radioactif, Saclay, France)

The movement of strontium 90 in soils is strongly increased under anaerobic decomposition of organic material. This relationship was observed in a Saclay soil under laboratory conditions, and at the same time the calcium reserves of the soil were lowered. The behavior of strontium and calcium were analogous. (tr-Auth) (CWF)

<386>

Gailledreau, C., Physico-Chemical Reactions in the Underground Movement of Radioisotopes. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962, (p. 269-275)

The physico-chemical state of the radioelements moving underground can influence considerably their migration velocity. In the case of Strontium 90, held on by monmorillonites, apatites, and activated aluminum oxide, the occurrence of

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electronegative colloids, selectively sorbing Strontium 90 results in an immediate break-through of this isotope. This phenomena was demonstrated in the case of the calcite phosphate reaction. A high pH is generally favorable to Strontium 90 ions (apatite, aluminum oxide). The occurrence of Ca (II) ions acts very unfavorably on Strontium 90 sorption by minerals specific of this isotope (apatite, aluminum oxide). The same thing occurs with organic matters: Cesium 137 sorption, attributed to illitic clays, is not very sensitive to the nature of the solution. Ruthenium 106 seems to move underground chiefly as a nitrosyl-ruthenium hydroxide complex. This complex would be weakly sorbed on soil colloids by London--Van der Waals forces. (Auth)

<387>

Gailledreau, C., and C. Berlin, Experimental Storage of Radioactive Waste at Shallow Depth. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967. (p. 251-259) (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Cadarache, France)

Solid radioactive waste may be stored safely in the soil at shallow depths provided it lies above the water table and is protected from any significant infiltration by rainwater. A facility was constructed whereby the buried waste is covered by a polyethylene umbrella with a surrounding drain. The walls and bottom of the waste pit itself are highly permeable and are made of large pebbles to catch any ground water diffusing laterally into the facility. Water from the drain surrounding the umbrella and from the bottom drain flows by gravity towards a nearby ravine, the bottom drain passing into a monitoring sump. To reduce water condensation beneath the umbrella, the latter is covered by a mound of earth 30 to 50 cm thick with turf on top, which acts as a thermal screen. The amount of water in the area in which the waste is stored--20 mCi of fission products-- and in the soil outside the facility is measured with a neutron moisture gauge, and the results of these measurements are given. It has been found that the volume filled by the waste constantly remains dry. The results of monitoring the drain sump are also quoted. Finally an estimate of the cost price of such storage per unit volume is given. (Auth)

<388>

Gaines, R.V., Cesium: Element and Geochemistry. 1972. Part of Fairbridge, R.W. (Ed.), The Encyclopedia of Geochemistry and Environmental Sciences, Volume IVA, Van Nostrand Reinhold Company, New York, New York. (p. 147-148, 278) (Not given)

The chemical and physical properties, abundance, content in minerals and rocks, geochemical behavior, and economic geology of cesium are briefly discussed. A table gives its concentration in different types of rocks. (ST)

<389>

Gal, M., and C.I. Rich, Selectivity Effect of Cesium on Clay Size Weathered Mica. Transmission Electron Microscopy Studies. 1972. Clays and Clay Minerals, 20, 175-179 (Virginia Polytechnic Institute and State University, Agronomy Department, Blacksburg, VA)

The use of electron diffraction contrast to detect local concentrations of interlayer cations in mica-vermiculites was examined. Cs and Mg, because of their contrasting atomic scattering amplitudes for electrons, were chosen as exchange ions for Ca. Cs was absorbed to the near exclusion of Mg by the clays from the three soils and by weathered clay-size muscovite and phloppite. The presence of Cs in addition to the other interlayer cations, K and Ca, caused bending and perhaps splitting of the mica-vermiculite layers. Extinction bend contours were common in Cs-treated specimens but not those Ca-treated. After freeze-drying of specimens of Cs-Ca Nason clay, differential destruction by the electron beam of the central core in clay-size vermiculite containing hydrated Ca ions may indicate the edge location of Cs. (Auth)

<390>

Gamble, J.F., Investigation of the Unusual Behavior of Cesium 137 and Other Radionuclides in the Florida Environment, Progress Report, June 1970 - April 1971. ORO-4066-1; 5 p. (University of Florida, Department of Environmental Engineering, Gainesville, FL)

Fallout monitoring data collected at various locations in Florida by the National Air Sampling Network, Radiation Surveillance Network, and Radiation Alert Network from 1963 through 1969 are compared with data from other areas of the USA, with emphasis on areas north and west of Florida. A steady decrease in yearly fallout and by latitude was evident. Data on the Cs 137 content in air filters located in Orlando, Pensacola, St. Petersburg, and Tallahassee during 1965, 1966, and 1967 and on fallout in precipitation are reviewed. The data show that Florida has not received more fallout than other areas in comparative latitudes. A comprehensive program to delineate the cause of the continued presence of elevated levels of Cs 137 in the Florida biosphere, milk, and vegetables is presented. Results from June 1970 to April 1971 show highest levels of Cs 137 in sandpine-oak scrub on dry infertile soils. These levels are much higher than in adjacent fields cultivated for annual crops. (NSA)

<391>

Gamble, J.T., R.A. Chu, and J.G.S. Fiskell, Soils and Agriculture of Eastern Panama and Northwestern Colombia. 1969. Bioscience, 19, 529-530 (University of Florida, Institute of Foods and Agriculture, Soils Department, Gainesville, FL)

The interaction of fallout radionuclides with soils used agriculturally in Panama and Colombia, as pertains to nuclear excavation of a sea level canal, is considered. Previous agriculture food chain relation studies were concerned primarily with Sr 90, Cs 137, and I 131. Other radionuclides that require evaluation are those of Ce, P, Mn, Fe, and W, and tritium. It was necessary to determine stable isotope levels for all of the essential elements in the food plants and soils of the area, and in addition, W, Cs, Sr, and Ce. Because of the importance of coconuts and bananas (plantains) and the lack of radioisotope uptake data, they were selected as the crops to be used in obtaining some first approximations of uptake, translocation, and concentration of critical radioisotopes. A special study of the beef industry was also made because of its potential in the economy of the area and, as an export commodity,

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potential radionuclide concentrations deserve special consideration. In environmental-radiation hazards analysis, the soil factor becomes more important with time. After the initial nuclear excavation, the direct contamination from fallout will cease and the soil will be the source of radionuclides. To assess the potential hazard from soil, a soil survey was made and principal soil types selected for detailed study. Soil samples were collected with all crop samples to correlate possible crop compositional variations with soil extract analysis. To further assess the potential of soils for nuclide retention, a radiotracer experiment was conducted. Six nuclides were compared in pairs (Fe 59-Mn 54, Rb 30-Cs 137, Ca 45-Sr 89). A table presents elemental analyses determined on soil extracts obtained by using neutral ammonium acetate as the extracting agent. (NSA)

<392>

Garrett, A.R., Jr., S.L. Cummings, and J.E. Reznier, Accumulation of Cesium 137 and Strontium 85 by Florida Forages in a Uniform Environment. 1971, July. Health Physics, 21, 67-70 (U.S. Public Health Service, Southeastern Radiological Health Laboratory, Montgomery, AL)

Experiments were made to define the possible role of differences in root uptake of Sr 90 and Cs 137 among forage crops in explaining variable milk concentrations of these radionuclides, particularly Cs 137. Nine forage species commonly used in the Florida area were grown for 95 days under greenhouse conditions in soil contaminated with Sr 85 and Cs 137. All species accumulated between 0.4 and 2.0 nCi/g of Sr 85; no statistically significant interspecies differences were observed. Significant interspecies differences in Cs 137 accumulation were found, with white clover accumulating about 65 nCi/g, bahiagrass 48 nCi/g, pangolagrass 28 nCi/g, and dallisgrass, oats, cratgrass, and 3 bermudagrass varieties about 35 nCi/g. Pangolagrass did not accumulate more Cs 137 than did the other forage species under the conditions of this study. The relation of these results to the previously established influence of pangolagrass on the high Cs 137 concentrations in Tampa, Florida, milk is discussed. (Auth)

<393>

Gast, R.G., An Interpretation of Self-Diffusion Measurements of Cations in Clay-Water Systems. 1962. Journal of Colloid Science, 17, 492-500 (University of Tennessee, Agricultural Research Laboratory, Oak Ridge, TN)

Diffusivities of eight cations in bentonite clay pastes were determined and the results interpreted in the light of available electrochemical and viscosity data. Evidence is presented which points toward the diffusivity of cations in the clay pastes as being a multiple rate process. Results suggest that contributions of (1) the diffuse layer and true solution ions and (2) the Stern layer ions dominate the diffusion process. (Auth)

<394>

Gast, R.G., and K.B. Deshpande, Properties of Clay Systems Controlling Ion Exchange Kinetics and Ion Exchange Equilibrium. ORO-672, 14 p. (University of Tennessee, Agricultural Research Laboratory, Oak Ridge, TN)

Progress is reported for studies of exchange between alkali metal cations on montmorillonites and selectivity studies on Chambers montmorillonite (ΔG° and ΔH° values). Ion exchange equilibria of alkaline earth cations on Wyoming bentonite were also investigated. Data are presented in graphic and tabular form. The differences between the behavior of alkali metal cations and alkaline earth metal cations was that the alkali metal pairs showed a distinct grading of selectivities whereas the alkaline earth cation pairs did not. (CO)

<395>

Gedeonov, L.I., Z.G. Gritchenko, V.M. Flegontov, and M.I. Zhilkina, Accumulation of Artificial Radionuclides on the Earth's Surface in the Region of Leningrad in 1954 to 1965. A-AC-82/G/L-1171; AEC-tr-7214, (p. 21-26)

The paper presents data characterizing the accumulation of total fission products and individual radionuclides on the earth's surface in the vicinity of Leningrad in the period 1954-1965. It is shown that the cumulative activity of radionuclides which fell out in the period of observation varied considerably, increasing with a certain delay after a series of tests and declining in the period of moratorium. An especially sharp decrease was noted in 1960, in January-August 1961, and in 1965. Long-lived radionuclides of strontium 90 and cesium 137 reacted less noticeably in the series of tests conducted before 1961, but the large release of those radionuclides in 1961-1962 caused a sharp increase in their accumulation on the earth's surface. By the end of 1965 the rate of accumulation of radionuclides with a half-life of 30-65 days (strontium 89, yttrium 91, zirconium + niobium 95, ruthenium 103 and cerium 144) from explosions in 1961-1962 had declined to zero. The accumulation of cerium 144 + praseodymium 144 was 120 millicuries/sq. km; of ruthenium 106, 41 millicuries/sq. km; of strontium 90, 41 millicuries/sq. km, and of cesium 137, 82 millicuries/sq. km. (Auth)

<396>

Gedeonov, L.I., and S.P. Rosyanov, Content of Some Fission Products in Forest Vegetation. 1968. Soviet Soil Science, 7, 942-944 (Radium Institute, USSR)

Samples of birch leaves, pine, and spruce needles taken in 1962 were studied for contamination with Sr 90, Cs 137, Ce 144, and Zr 95. It is shown that the content of fission products in birch leaves depends on their age. It is found that the content of these radionuclides is higher in spruce needles than in pine needles. The observed differences in radioactive contamination of the various coniferous species is related to the capacity of the trees for retaining atmospheric precipitation. (Auth)

<397>

Gedeonov, L.I., S.P. Rosyanov, and V.K. Vinogradova, Influence of Herbaceous Vegetation on Radioactive Contaminations in Soils. 1967. Pochvovedenie, 10, 124-126

The uptake of fission products by grass and the level of fallout products in soil specimens collected during 1962-1964 were evaluated and compared in order to determine the influence of the uptake of fission products by plants and grasses on the level of soil contamination. It was estimated that about 20 percent of fallout radioactive

<397> CONT.

materials were absorbed from the air and retained by the plants and included in the biological cycle. (NSA) (CWF)

<398>

Gersper, P.L., Effect of American Beech Trees on the Gamma Radioactivity of Soils. 1970. Soil Science Society of America Proceedings, 34, 318-323 (Ohio Agricultural Research and Development Center, Wooster, OH)

Various factors that affect the distribution of gamma-emitting radioisotopes in soils under mature American beech trees (*FAGUS GRANDIFOLIA* L.) were investigated. Because of its smooth bark and consequent greater amounts of stemflow this species concentrates more fallout radioisotopes in soil near its stems than most other species. Soil near the stems of beech trees contained considerably more fallout and was subjected to greater leaching of natural radioisotopes, to a depth of 30 cm or more, than soil not affected by stemflow water. Depth penetration of fallout and leaching of natural radioisotopes was greater in Dekalb fine sandy loam than in Bennington silt loam. Radioisotope distribution in soil under these trees was also affected by variations of stemflow around the stems, slope gradient, and the quantity and distribution of organic litter on the forest floor. Near two trees that had variable stemflow, the surface soil contained an average of five times more fallout on the high-stemflow sides of the stems than on the low-stemflow sides. Under a beech tree growing on a 20 percent slope, soil on the downslope side of the stem contained more fallout than soil on the upslope side. Organic litter had a much higher content of fallout than of naturally occurring radioisotopes. As a consequence of the greater concentrations of fallout, herbaceous plants, spicebush (*LINDERA BENZOIN* L.), and American beech saplings growing near the stems of mature beech trees had higher uptakes of these radioisotopes than those growing farther from the stems. (Auth)

<399>

Giannotti, G.P., M. Mitterpercher, and G. Sidoti, Selection Criteria for Ground Disposal Sites for Solid Radioactive Waste in Highly Populated Areas. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967. (p. 319-328) (Comitato Nazionale per l'Energia Nucleare, Casaccia, Italy)

In contrast to deep disposal of radioactive waste, which ensures virtual isolation, shallow disposal is influenced directly by possible interaction of the waste with natural waters and indirectly by a number of other environmental factors. In examining Italy for potential waste burial sites, various criteria were studied and priority allotted to certain of these. The six most important criteria for consideration are: geology, hydrology, vulcanology, seismicity, climatic details and the population density associated with a proposed site. In addition, other factors that may need to be considered included economy, pedology, soil utilization, bathymetry, ecology and ground organization. It is believed that the investigations undertaken in Italy may be applicable to other countries with high population densities. (Auth)

<400>

Gibbs, W.J., W.K. Matthews, J.R. Moroney, D.J. Stevens, and E.W. Titterton, Strontium 90 in the Australian Environment During 1968. 1969. Australian Journal of Science, 32, 238-244 (Commonwealth Bureau of Meteorology, Australia; United Kingdom Atomic Energy Authority, Chemical and Metallurgical Services, Capenhurst Works, Australia; Commonwealth Department of Supply, Australia; Commonwealth X-Ray and Radium Laboratory, Australia; Australian National University, Research School of Physical Sciences, Sydney, Australia)

Strontium 90 concentrations in various environmental samples in Australia are presented. (CWF)

<401>

Gille, G.L., and E.R. Graham, Isotopically Exchangeable Cobalt: The Effect of Soil pH and Ionic Saturation of the Soil. 1971. Soil Science Society of America Proceedings, 35, 414-416 (University of Missouri, Department of Agronomy, Columbia, MO)

Large increases in the uptake of Co, Zn, and Mn by sudangrass (*SORGHUM VULGARE SUDANENSE*) were observed when FeCl_2 , AlCl_3 , and CaCl_2 were added to the soil in which the plants were grown. The isotopically exchangeable cobalt in the soil remained unchanged regardless of soil pH or the addition of Fe, Al, or Ca to the soil. (auth) Increases in the cobalt content of sudangrass result from changes in the soil solution concentration of cobalt in the soil rather than quantity of cobalt. The effect of Fe, Al, and Ca additions and soil pH in producing the changes in cobalt content of sudangrass was caused by soil factors rather than changes in plant response. One hundredth normal HCl was found to be a useful extracting agent for determining the quantity of cobalt in the soil and 0.1 M CaCl_2 would give the best indication of the potential soil solution concentration (I) of cobalt in the soil.

<402>

Gillette, R.K., M.L. Curtis, E.B. Munn, J.O. Frye, and C.T. Bishop, Investigation into the Determination of Plutonium in Soil by a Fusion Procedure. 1972, June. MLM-1901; 26 p. (Mound Laboratories, Miamisburg, OH)

A method for the determination of plutonium in soil is discussed. The method involves complete dissolution of the soil by a fusion technique followed by chemical separation of the plutonium, electrodeposition, and alpha pulse height analysis. Results are given for analyses of a spiked soil sample and four soil samples previously analyzed by a procedure in which the plutonium is acid-leached from the soil. The analysis of the spiked soil indicated good accuracy and precision of the fusion method. The results of the analyses of the four soil samples indicated agreement with the leaching results, but indicated that the plutonium was probably not uniformly distributed in the soil. (Auth)

<403>

Globel, B., H. Muth, and E. Oberhausen, Intake and Excretion of Natural Radionuclides Lead 210 and Polonium 210 by Humans. 1966. Strahlentherapie, 131, 218-226; ANL-trans-458; 11 p. (Boris-Rafajewsky Institute, Homburg, German Federal Republic)

Present investigations were done in order to obtain a survey of Pb 210 and Po 210 intake

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with food and drinking water and of the excretion of both these radionuclides in humans. With the instrumentation used, specific activities of Pb 210 and Po 210 as low as 2×10^{-16} Ci/g of substance could be determined. The results showed that a normal person takes in, on the average, 4 to 5 pCi of Pb 210 and Po 210 per day in the diet. The excretion has the same order of magnitude; great daily variations were observed for intake and excretion. It could be shown that grassy plants take up both nuclides from the soil and by direct absorption from precipitation above the soil. (Auth)

<404>

Godse, V.B., A.L. Mohan, M. Singh, R.V. Amalraj, and K.T. Thomas, Characterization of Trombay Soils for Disposal of Radioactive Waste. 1967. BARC-297; CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (n. 301-315) (Bhabha Atomic Research Centre, Bombay, India)

Laboratory and field studies were carried out for the characterization of the Trombay soils and ground water to investigate the criteria for safe disposal of radioactive wastes. Physical and chemical properties of the soils were determined in order to evaluate their suitability for retention and leaching characteristics of radionuclides of interest. The soil covering consists of silty clay to clayey type of soil having a base exchange capacity of 34 to 76 mequiv/100 g. The relative velocity factors for the radionuclides of interest have been evaluated in the laboratory with respect to ground water velocity of the area. Field studies were conducted by establishing a series of bore holes in a grid pattern and field permeability was determined to find out the velocity of ground water in the area. Tracer experiments were also conducted for the rate and direction of ground water movement. An experimental study of direct discharge of solid waste from a chemical plant to the soil environment indicated that there was slight leaching of activity immediately after monsoon. In view of the prevailing geological, hydrological, and climatic conditions at Trombay area, the general policy followed for ground disposal of radioactive wastes is to contain it in solid form with adequate monitoring and environmental surveillance. (Auth)

<405>

Goldsmith, W.A., Radionuclide Retention from Dilute Solutions by Panamanian Soil Clays. 1968. Ph.D. Thesis: 168 p. (University of Florida, Gainesville, FL)

The retention of the radionuclides Ca 45, Sr 89, Cs 137, and Rb 86 was determined for six selected Panamanian soil clay fractions. The clays were separated from soils representing the major types present in the sea level canal feasibility study area. The sorption of the radionuclides was determined using the slurry test. The slurries were run with the radionuclides paired into two stock solutions: Cs 137 with Rb 86 and Ca 45 with Sr 89. Gamma emitters were counted by gamma spectroscopy, beta emitters by liquid scintillation counting. Each stock solution was prepared from commercially prepared radionuclide chloride solutions diluted to 50 microcurie/liter with distilled water. The results of the slurry test followed the linear function $C/U = b(K_2/K_1) + bc$ where U is the

percent uptake at clay concentration C ; b is the inverse of the ultimate uptake, the percentage of radiocations which would ultimately be sorbed from solution by an infinite mass of clay; (K_2/K_1) is the half dosage, the clay concentration required to sorb one-half of the ultimately sorbable cations, expressing the efficiency or selectivity of the clay for sorbing the radionuclide. This equation was derived on the basis that the mass of clay is the most important consideration in the determination of radionuclide uptake by the slurry test. The derivation was analogous to that of the Langmuir adsorption isotherm. The results obtained for the six Panamanian soil clays suggested that the soil colloid fraction in the Panamanian study area represents a limitless reservoir capable of sorbing soluble fallout radiocations that would be produced in nuclear excavating techniques. The selectivity for each Panamanian soil clay under the conditions for which they were tested, expressed by the half dosage, generally followed the sequence: $Ca\ 45 = Sr\ 89 > Cs\ 137 > Rb\ 86$. Neither the ultimate uptake nor the half dosage could be correlated with either the cation exchange capacity or surface area parameters of the six clays tested. The results of slurry tests performed by seven other investigators also were well described by the equation derived in this study. All results indicated that the half dosage requirement of a radionuclide for any clay depended on the type of clay mineral present, the ionic size and charge of the radionuclide, the chemistry of the substrate solution, and the time of contact for nonexpanding lattice, clay minerals. The ultimate uptake value was apparently influenced very slightly by the type of clay mineral involved and by the chemical nature of the substrate solution. (Auth)

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Golutvina, M.M., L.S. Semochkina, and N.N. Kononykina, Uptake of Strontium 85 by Hydroxyapatites of Biological Origin. 1972. Biol. Nauki, 3, 56-60 (Institute of Biophysics, Moscow, USSR)

The kinetics of Sr 85 absorption from barbiturate buffer by hydroxyapatites which have been separated from bone tissues of man and rats were studied. Rapid phases of the process were completed in 4 to 6 hr in the manner of reverse ion exchange adsorption. Slow recrystallization of the bone mineral occurred, accompanied by weak capture of the isotope by the crystals. Kinetic parameters of the adsorption reaction of Sr 85 by the two hydroxyapatites studied were quite similar. (tr-Auth)

<407>

Gonzales, J. de D.I., and H. Jenny, Mode of Entry of Strontium into Plant Roots. 1958. Science, 128, 90-91 (University of California, Berkeley, CA; Universidad de Granada, Granada, Spain; Junta de Energia Nuclear, Spain)

Data from two experiments are presented which support the hypothesis of contact exchange in the entry of strontium into plant roots. (CWF)

<408>

Gonzalez Garcia, F., and A.M. Garcia Gomez, Geochemistry of Cobalt in Soils of Western Andalusia. I. General Characteristics and Total Cobalt Content in Soils of the Guadalquivir Valley. 1964. An. Edafol. Agrobiol., 23, 305-321

<408> CONT.

The Co content of parent rocks was 4-5 parts per million in the purest Tertiary chalks, 10-12 in the more weathered chalks, 8 parts per million in granitic rocks and 12-14 in Paleozoic slate. Co content of soils was 11.2 parts per million in xerorendzinas and serozems, 10.6 in black earth, 9.2 in red loam, down to 6.6 in red bottcand soils, 6.2 in terra rossa and calcareous solonchaks and 4.2 in brown earths on granite. In calcareous soils, except black earths, Co decreased with depth. The ratio of Co in horizons to Co in rock can be used as an index of the mobilization and washing of the Co in the soil: the ratio is positively correlated with soil pH. (Soils and Fertilizers)

<409>

Gonzalez Garcia, F., and A.M. Garcia Gomez, Geochemistry of Cobalt in Soils of Western Andalusia. V. Cobalt Extractable by Ammonium Acetate and Acid Solutions, and Representation of the Cobalt Cycle. 1964. An. Edafol. Agrobiol., 23, 697-704

Ammonium acetate at pH 7 extracted neqliqible amounts of Co from soils of the Guadalquivir valley. Greater amounts were extracted when the acidity was increased to pH 3 or the extractant was 0.1 or 0.5N HCl. Insolubility of Co was attributed to the highly dehydrated free oxides. A diagrammatic representation is given of the Co cycle in soils. (Soils and Fertilizers)

<410>

Gonzalez Garcia, F., and A.M. Garcia Gomez, Geochemistry of Cobalt in Soils of Western Andalusia. IV. Cobalt in Clays and Correlation Between Cobalt and Iron, Clay and Manganese Contents. 1964. An. Edafol. Agrobiol., 23, 563-572

There is no correlation between the Co content of clays of Andalusian soils and their MgO , SiO_2 , Al_2O_3 or TiO_2 contents. A high positive correlation exists between total Co in clays and their Fe content expressed as Fa_{203} . Most of the Co was found in combination with oxide and hydroxide gels associated with the clays. The remainder is probably present as lattice component of the clay minerals. There is good positive correlation between total Co and total Mn in soils of the Guadalquivir valley. Regression equations are given. (Soils and Fertilizers)

<411>

Gordon-Gray, C.G., and F.D. Schlosser, Modified Degradative Procedures on Carbon 14 Compounds in Biosynthetic Studies. 1969. J. S. Afr. Chem. Inst., 22, 165-167 (University of Natal, Pietermaritzburg, South Africa)

In numerous biosynthetic studies in which C 14-labeled precursors are used, this degradation of the product necessitates definite procedures to enable the activities of the various constituent carbon atoms to be established. Some of the more useful methods are described and illustrated by reference to recent work on the biosynthesis of Senecio alkaloids. One method involves C 14-methyl determination and the assessment of the activities of the carboxy and methyl carbons of the resultant acetic acid. Kuhn-Roth oxidations are capable of yielding useful information on the general distribution of the C 14 activity within a compound, since it is possible to ascertain the activity not only of the C 14-acetic acid generated but also of the

C 14-carbon dioxide liberated during the oxidation. The usual procedure was simplified by the pyrolysis of barium acetate in a C-H combustion apparatus in a stream of oxygen. The reaction proceeded as previously, except that the acetone, if formed, was totally combusted to carbon dioxide. The barium carbonate remaining was regenerated with phosphoric acid. In the conversion of iodoform to carbon dioxide it was found that wet oxidation was unsuitable when using the proportional counter, possibly due to contamination of the barium carbonate with iodine. It was found advantageous to modify this method by converting the iodoform to carbon monoxide using silver nitrate without ethyl alcohol. An example of the results is outlined. (NSA)

<412>

Grabovnikov, V.A., and L.M. Samsonova, Influence of the Form of Uranium Occurrence in Solutions on Its Sorption by Natural Mineral Formations. 1968. Geokhimiya, 10, 1250-1258

Results of an experimental study of the quantitative ratio between uranium content in solution in different forms and its capacity for being sorbed by the natural ground are stated. Synthetic solutions were investigated being analogous by their composition to natural waters with U(+6) from 2.7×10^{-5} to 6×10^{-3} g/l, an ionic strength from 0.02 to 1 and a pH from 6.45 to 7.45. Results obtained were: (1) the investigated ground extracts uranium from solutions only present in a cationic form; (2) sorption of uranium in a cationic form obeys certain regularities known in physical chemistry the Freundlich equation and others; and (3) the obtained data agree with the widely known conclusions about the high mobility of uranium in the hypergenesis zone where uranium prevailingly is present in the form of complex anions (carbonate uranyl complexes). (Auth)

<413>

Graham-Bryce, I.J., Effect of Moisture Content and Soil Type on Self-Diffusion of Rubidium 86 in Soils. 1963. Journal of Agricultural Science, 60, 239-244 (University of Oxford, Department of Agriculture, Oxford, England)

Measurements of diffusion coefficients of Rb in soil at a wide range of soil moisture contents revealed the moisture content had a large effect on the coefficient value. The most rapid rise was found to be between 5 and 10 percent soil moisture, but the effect was concluded not to be simply to the increased volume water but rather other factors. A general figure for the diffusion of Rb in soils was found to be 1.0×10^{-7} cm²/sec. (CWF)

<414>

Graham, E.R., Chemical Environment of Plant Roots as a Factor in the Uptake of Radionuclides by Plants. 1967, June 26. TID-23955; 20 p. (University of Missouri, Columbia, MI)

Summaries are presented of investigations concerned with the effects of mineral and organic colloids; radioisotope saturation; content of cations, hydrogen ions (pH), nitrogen, and salts; and soil microorganisms on the distribution of fission products in soils and the uptake of fission products from the soil by garden peas, rye, and soybeans. (NSA)

<415>

Graham, E.R., Uptake of Waste Strontium 90 and Cesium 137 by Soil and Vegetation. 1958. Soil Science, 86, 91-97 (University of Missouri, Columbia, MO)

A survey of strontium 90 and cesium 137 was made in the alluvial material remaining after drainage of White Oak Lake, an impoundment used as a final settling basin for the low-level waste effluents from Oak Ridge National Laboratory. The concentration of strontium 90 and cesium 137 was also determined in POLYGONUM LAPTHIFOLIUM (swart weed) which began to grow in the spring of 1956. Strontium 90 concentrations varied between 0.057 and 0.178 uCi per 100 gram of dry plant material and seemed to be lowest in areas associated with high sodium and calcium in the sediment. Cesium 137 concentrations ranged from 0.-133 to 0.334 uCi per 100 gram dry plant material and higher concentrations appeared to be associated with areas of the drained impoundment which were moderately low in available potassium. (CWF)

<416>

Graham, E.R., and L.H. Kampbell, Soil Potassium Availability and Reserve as Related to the Isotopic Pool and Calcium Exchange Equilibria. 1968. Soil Science, 106, 101-106 (University of Missouri, Agricultural Experiment Station, Columbia, MO)

Factors affecting the availability of potassium and calcium in soils of Northwest Missouri are evaluated. Soils containing the largest labile pool of potassium showed the highest uptake of potassium by plants and also reflected total soil potassium. (CWF)

<417>

Graham, E.R., and D.D. Killion, Soil Colloids as a Factor in the Uptake of Cobalt, Cesium, and Strontium by Plants. 1962. Soil Science Society of America Proceedings, 22, 545-547 (University of Missouri, Columbia, MO)

A study of the uptake of Co, Cs, and Sr by rye, garden peas, and soybeans showed that the amount of these elements harvested, as well as the concentration in the plants, varied with the nature of the soil colloid on which they were grown. Illite, kaolinite, montmorillonite, peat (fibrous), peat (sedimentary), and Putnam clay were Ca-saturated, mixed with nutrients and sand, and treated with known amounts of radioactive Co 60, Cs 137, and Sr 85. Cultures of rye, peas, and soybeans were started in sand-nutrient solution mixtures, then transferred to the radioactive colloid-sand-nutrient mixture. After a period of growth, the plants were harvested, weighed and assayed for their content of radioactivity. A study of the adsorption of the nuclides by the colloids was made by the determination of the distribution coefficient of each radioactive nuclide as a trace amount in Ca-saturated exchange systems in 0.01M CaCl₂ solution. The order of uptake of Co by the rye plants was highest on illite followed in order by kaolinite, Putnam clay, peat (sedimentary), montmorillonite, and peat (fibrous). The uptake of Cs by the rye plants was highest in the plants grown on (fibrous) peat (10.59 percent harvested), and lowest for the plants grown on Putnam clay (0.36 percent harvested). The uptake of Sr by the rye plants was highest for the plants grown on montmorillonite (2.08 percent harvested). The uptake of the nuclides by peas and soybeans followed closely that of rye. Data obtained

from the distribution coefficient studies of the elements for the exchangers after equilibration in 0.01M CaCl₂ solution reveals more Co adsorbed by the peats than by the clays; a high adsorption of Cs by illite and Putnam clays; and small differences with Sr with exchangers other than kaolin. The adsorption of the three elements was lower for kaolin than for the other cation-exchangers. The percentage of Co and Cs harvested by the plants was correlated with the reciprocal of the distribution coefficient. (Auth)

<418>

Gray, L.E., and J.W. Gerdemann, Influence of Vesicular-Arbuscular Mycorrhizas on the Uptake of Phosphorus 32 by LIRIODENDRON TULPIPERA and LIQUIDAMBAR STYRACIFLUA. 1967. Nature, 213, 106-107 (University of Illinois, Urbana, IL)

Results of experimental work described indicate the vesicular-arbuscular mycorrhizas enhance uptake of P 32 by the host plant from nutrient solution and from soil, and that the function of vesicular-arbuscular mycorrhizas is similar to that of ectotrophic mycorrhizas. (NSA)

<419>

Grebenshchikova, V.I., Yu. P. Davydov, and A.S. Pershin, The Adsorption of Plutonium(+4) on a Precipitate of Barium Sulfate. 1971. Soviet Radiochemistry, 13, 457-459

Mechanisms relating to the adsorption of plutonium (IV) on a barium sulfate precipitate at various solution pHs, electrical potential and time are evaluated. (CWF)

<420>

Green, J.H., and E.T. Pallister, Radiochemical Analyses for Strontium 90, Cesium 137, Radium 226, and Potassium 40 in Natural and Processed Materials in Australia. 1965. Australian Journal of Science, 27, 199-202 (University of New South Wales, Department of Nuclear and Radiation Chemistry, Sydney, Australia)

Strontium 90, Radium 226, and Potassium 40 were determined in some selected materials, such as tobacco, tea, and coffee. Results are given for analyses of various processed materials in Australia, as well as for rainwater in Sydney. Apart from the tea samples, the results showed levels of Sr 90 similar to those found in flour from Australian wheat. This was so even though the ratio of total strontium to total calcium was lower in these samples than in flour. A sample of Chinese tea had a Sr 90 content (2080 uCi/g Ca), which was about 340 times the content of Sydney milk sampled at the end of 1961. The results indicated a greater fallout in tea-growing areas and perhaps a selective uptake of Sr 90 by the tea plant. For tea packed in Australia the highest figure (321 uCi/g Ca) was 53 times the level in the milk samples. A rough estimate of the maximum amount in a pot of Australian tea gave 13 uCi/l of tea, or one-thirtieth of the MPL for drinking water. The Sr 90 and Cs 137 contents in monthly precipitation collections for the two years from April 1962 to April 1964 are listed and the estimated corresponding surface fallout is shown. These results showed concentration peaks for Sr 90 and Cs 137 in October to December 1962 and November to December 1963. Average ratios of Cs 137 to Sr 90 specific activities in 1962 and 1963 were 1.34 and 1.45. Results are tabulated of the comparative contents of the three nuclides, Sr 90, K 40, and Ra 226 in tea, coffee, and

<420> CONT.
tobacco. (NSA)

<421>
Gregers-Hansen, B., Fixation of Radioactive Strontium in Soil. 1964. Nature, 201, 738-739 (Danish Atomic Energy Commission, Agricultural Research Department, Risoe, Roskilde, Denmark)

The influence of time, phosphorus and heat were evaluated in terms of extractable soil radiostrontium. (CWF)

<422>
Gregory, L.P., Polonium 210 in Leaf Tobacco from Four Countries. 1965, October. Science, 150, 74-76 (National Radiation Laboratory, Christchurch, New Zealand)

Tobaccos grown in the United States, Rhodesia, South Africa, and New Zealand were measured for their polonium 210 content. Details of the method of measurement are given and the results are listed. A mean of 0.15 picocurie per gram was found in New Zealand tobacco, compared with 0.49 picocurie per gram in United States tobacco. The concentration in South African tobacco was approximately the same as in United States tobacco, but the level in Rhodesian tobacco appeared to be significantly higher. (Auth)

<423>
Grigal, D.F., Calcium Cycling: Diffusion into a Forest Soil. 1971. CONF-710510; Part of Proceedings of the Third National Symposium on Radioecology held in Oak Ridge, Tennessee, May 10-12, 1971, 20 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

Calcium 45 was introduced into red maple trees in spring and the leaves were harvested in autumn and laid on the floor of an oak-hickory forest. Movement of Ca 45 from the leaves into other components of the ecosystem, and particularly into the soil and soil water systems, was monitored for two winters and the intervening summer by periodic sampling of soil, litter, and soil water. After 72 weeks, approximately 50 percent of the Ca 45 had moved into the soil. Activity of the isotope decreased exponentially with depth and little had moved below 20 cm. Some of the isotope had also cycled through the surrounding vegetation and back to the soil surface. The Ca 45 did not move into the soil in solution but instead moved by surface or exchange diffusion along the soil particles. A grain-boundary diffusion model, which infers rapid diffusion along pores and slow diffusion into soil beds, was used to predict this movement. (Auth) (CWF)

<424>
Grison, G., Migration of Radioelements in the Soil. 1967. Mem., Ass. Int. Hydrogeol., Reunion Istanbul, 8, 392-414; CONF-670972; Part of 8th Congress of the International Association of Hydrogeologists, Istanbul, Turkey

A brief review is presented of the studies of various factors affecting the transport, distribution, and dispersion of radionuclides in the soil. The solubility of the waste material, physico-climatic, and biological properties of the environmental media are discussed. Tabulated data are included in the comparisons of various methods of detection based on chemisorption, exchange, and fluid sample drying calibration. (NSA)

<425>
Gromov, V.V., Desorption of Microquantities of Strontium and Cesium from Montmorillonite and Kaolinite. 1960. Russian Journal of Physical Chemistry, 34, 651-654 (USSR Academy of Sciences, Institute of Physical Chemistry, Russia)

Russian adsorption and desorption studies of strontium and cesium to montmorillonite and kaolinite revealed that strontium 90 adsorption is completely reversible while cesium is only partially reversible. (CWF)

<426>
Grueter, H., Retention of the Fission Product, Cesium 137, in Domestic Species of Fungi. 1967. Z. Lebensm.-Untersuch. Forsch., 134, 173-179 (University of Munster, German Federal Republic)

Investigations on the artificial radioactivity of vegetation as a result of nuclear bomb tests gave an unusually high concentration of the fission product Cs 137 in various fungi. Although several fission products were present in the soil, except for Cs 137 and a small amount of Sr 90, no other artificial radioisotopes were taken up in the mineral content of the fungi. In contrast with K, which constitutes the greatest part of the inorganic fungi constituents, Cs 137 was preferentially enriched by more than an order of magnitude in comparison with the Cs 137 concentration in the soil. The nature of the soil has a very strong effect on the Cs 137 content of the fungi: pine needle soil showed the highest value, deciduous forest soil was much less, and meadows, in general, had no detectable fission product activity. In a cooking study with Kremppling (PASCILLUS INVOLUTUS) 64% of the Cs 137 activity was transferred to the cooking water. A significant contribution to the radiation burden of man is not likely because of the relatively low value of fungi as a food. (tr-Auth)

<427>
Grueter, H., Radioactive Fission Product Cesium 137 in Mushrooms in West Germany During 1963-1970. 1971. Health Physics, 20, 655-656 (University of Muenster, Muenster, German Federal Republic)

Investigations of various specimens of mushrooms in the months of September and October over a period of seven years showed a striking selectivity in the resorption of Cs 137 from soil. Accumulation depended on the species and local soil properties. Highest activities were measured in BOLETUS EDULIS and B. BADIUS, and in PASCILLUS INVOLUTUS growing in sandy pine needle soils. Mushrooms in leafy woods had substantially lower values and those from meadows (AGARICUS COMPESTEIS) showed almost no fission products. The differences were too great to be explained by variations in Cs 137 content of different soils and were believed to be due to the adsorption conditions of soil types. The peak value measured was $3.06 \times 10^{(2+4)}$ pCi/g fresh weight. The actual incorporation depended on cooking. Typical values of Cs 137 were tabulated for species of PASCILLUS, CANTHARELLUS, AGARICUS, and BOLETUS. Activity was compared with that in beef and milk. (Auth)

<428>
Grummitt, W.E., Strontium 90 and Cesium 137 in Canadian Cereal Grains 1957-1960. 1964. Can. J. of Bot., 42, 367-374 (Chalk River Nuclear

<428> CONT.
Laboratories, Chalk River, Ontario, Canada)

The concentration of cesium 137 and strontium 90 in Canadian wheat is reported for the years 1957 to 1960. Some results are included for flour, bran, barley, and wheat from earlier years. Sampling was done through a national network to obtain as representative results as possible. The specific activity, i.e. strontium 90/mg stable strontium, in various parts of the wheat kernel has been used to study the uptake of strontium by the plant. For wheat grown under conditions of high fallout, more than 40 percent of the strontium 90 in the cereal grain was absorbed through the husk. A comparison of cesium 137 in wheat with fallout rate showed negligible (less than 5 percent) uptake from soil. (Auth)

<429>
Grunnutt, W.E., Cesium 137 and Strontium 90 Soil Profiles, Progress Report, October 1 - December 31, 1968. 1968. PR-B-80 (Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada)

The distribution and method by which cesium 137 and strontium 90 are moved through some Canadian soil profiles are presented. (CWF)

<430>
Grunnutt, W.E., and G. Lahaie, A Method for the Determination of Strontium 90 and Cesium 137 in River Sediments and Soils. 1973, March. AECL-4365; 12c. (Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada)

A method for the simultaneous determination of strontium 90 and cesium 137 in soil and silt is outlined. Using this procedure the nuclides can be measured in amounts as low as 0.1 pCi/100g. Chemical yield normally varies from 65 to 80% of the radioactivity present in the sample, so that for cesium 137 the method is appreciably more sensitive than gamma spectrometry. (Auth)

<431>
Grunnutt, W.E., and G. Lahaie, Uptake of Cobalt 60 by Edible Plants, Progress Report, October 1-December 1971. 1972. PR-B-92 (Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada)

Gamma-ray spectrometric analyses of plants grown in 1970 and 1971 are almost complete. The results show a strong dependence on the type of soil. Two organic soils, peat and sludge, show opposite behavior with cobalt and cesium. Cobalt is readily taken up by the plant from sludge but is retained by the peaty soil. This behavior is in agreement with the retention of cobalt 60 in Perch Lake Swamp. (Auth)

<432>
Gruzdev, B.I., and D.M. Rubtsov, Accumulation of Thorium, Uranium, and Radium by Plants and Organogenic Horizons of Soils. 1972. Part of Verkhovskaya, I.N. (Ed.), Radioekologicheskie Issledovaniya v Prirodnykh Biotsenozakh, Izdatelstvo Nauka, Moscow, USSR, (p. 112-123) (Not given)

The accumulation and distribution of thorium, uranium, and radium in plants of the taiga zone was studied in relation to the content of radioelements in the soil. Only radium is accumulated by plants in substantial quantities, its biological accumulation coefficients as a rule exceeding 1.0. It was

found that the European mountain ash (*SCORBUS AUCUPARIA* L.) is possessed of a selective capacity of radium absorption, expressed in its high absolute content (up to n. 10(E-8)%) and characterized by a significant (up to 100) accumulation coefficient. Uranium and thorium accumulation coefficients are as a rule lower than 1, decreasing to 0.09 to 0.01 with a considerable increase of thorium in the soil. The study of the distribution of radioelements in plants showed that the greatest quantities of these elements concentrate in the older organs and tissues (bark, branches, wood) and the least in young ones (leaves, inflorescences). It is shown that radium, uranium, and thorium are elements with an acropetal distribution. The accumulation of thorium in forest litters follows the same trend as in the vegetative cover, that is no enrichment of the humus horizon with thorium is observed at a high content of this element in the soil. (Auth)

<433>
Grzybowska, D., Cerium 144 - Praseodymium 144, Cesium 137 and Strontium 90 Content in Soil in Poland in the Year 1964. 1967. CLOR-63/D; 26p. (Central Laboratory for Radiological Protection, Warsaw, Poland)

Radiochemical analyses of surface-layer samples (0 to 5 cm) of soil from the vicinity of Warsaw in 1964 showed an average content of 89 mCi to Ce 144 + Pr 144/km², 24 mCi Cs 137/km² and 20 mCi Sr 90/km². Among the most frequently occurring in Poland's 4 kinds of soil, silt presented the highest radioactivity. Detailed results of radionuclide content as well as additional determinations (incineration coefficient, the total sum of exchangeable bases, pH, calcium and potassium content) are presented in tables and diagrams. The results of determination in layer samples from 0 to 30 cm showed that the surface layer (0 to 5 cm) contains about 90 percent of radioelements detected in the 0 to 30 cm layer. (Auth)

<434>
Grzybowska, D., Uptake of Strontium 90 and Cesium 137 by Plants from Contaminated Soils. 1972. Nukleonika, 17, 331-340 (Central Radiological Laboratory, Warsaw, Poland)

In order to investigate the possibility of reducing the uptake of radioactive Sr 90 and Cs 137 by plants, grass (*DACTYLIS GLOMERATA*) and alfalfa (*MELEGAGO SATIVA*), were grown, the contamination depths being 0 to 10 cm and 20 to 30 cm. A marked reduction of Sr 90 and Cs 137 uptake with depth of their placement was observed. Transfer coefficient for soil-plant system for the plants investigated and soil types are given. (Auth)

<435>
Grzybowska, D., and S. Wlodek, Contribution to the Study of Soil-Plant Transfer Factors of Strontium 90, Cesium 137, and Radium 226. 1972. EUR-4800: Part of Proceedings of an International Symposium on Radioecology Applied to the Protection of Man and His Environment held in Rome, Italy, September 7, 1971, (p. 1069-1079) (Not given)

In an attempt to devise means of reducing the absorption of Sr 90, Cs 137, and Ra 226 by plants growing in contaminated soil, an experiment was conducted using the following three types of soil: sandy, podzolic, and humus; two types of radioisotope distribution in the profile: contamination at surface and a

<435> CONT.

depth of 20 cm; and two plant species: the grass, *DACTYLIS GLOMERATA*, and the alfalfa, *MEDICAGO SATIVA*. The results obtained made it possible to demonstrate the differences between the transfer factors for strontium, cesium, and radium released to the environment and to assess the influence of soil characteristics and tillage on the reduction of these factors. (Auth)

<436>

Guedalia, D., J.L. Laurent, J. Fontan, D. Blanc, and A. Druilhet, A Study on Radon 220 Emanation from Soils. 1970. *J. Geophys. Res.*, 75, 357-369 (University, Faculte Des Sciences, Toulouse, France)

A measurement method of Rn 220 soil emanation is presented. Some measurements were made by means of an experimental model in the laboratory in order to determine the influence of certain parameters on the emanation rate. The seasonal and daily variations of the Rn 220 flux were also studied. It is shown that the seasonal variations are related to soil moisture variations, whereas some daily variations are due to the temperature difference between the air and the soil. (Auth)

<437>

Guennelon, R., A.P. Conesa, A.M. De Cockborne, and P. Drujon, Aspects of Strontium Availability and Absorption by Plants in Chalky Soils. 1970. CONF-690918-(Vol. 2): Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 761-780), 506p. (Institut National de Recherches Agronomiques, Montfavet, France)

The interaction of strontium with calcium carbonate was studied. A maize crop produced on a simplified model shows that the presence of polyphosphate causes an appreciable increase in the absorption of strontium by the young shoots as compared with the orthophosphate treatment, the presence of chelates leading to a reduction under experimental conditions. A rye grass cultivated on a Strontium 90-contaminated chalky soil, in which was incorporated a chelate or a polyphosphate or organic matter, showed no increase in its Strontium 90 content with respect to the contaminated reference crop treated simply with orthophosphate. (Auth)

<438>

Guennelon, R., A.P. Conesa, and A.M. De Cockborne, Interrelated Properties of Soils and Strontium Uptake by Ryegrass Grown on Calcareous Soils. 1972. *Ann. Agron.*, 23, 497-515 (National Institute of Agronomy Research, Avignon, France)

A Sr input tagged just before cultivation of ryegrass has a contamination ratio solely dependent on the exchange ratio of the soil. The total Sr absorbed is an increasing function of the exchangeable Sr exchange-capacity ratio. A lower rate of contamination can be secured by altering the exchange capacity with larger than practical amounts of clay or organic material. Some effect can be expected in sandy soils with very low cationic exchange capacity. (SI)

<439>

Guizeris, J., J. Molinari, B. Gaillard, C.H. Santos, A. Mornas, and R. Corda, Localization of Leakages from a Large Reservoir Using Radioactive

Tracers. 1967. CCNF-661133; STI/PUB-141; Part of Proceedings of a Conference on Isotopes in Hydrology held in Vienna, Austria, November 14-18, 1966, (p. 587-599), 740 p. (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Grenoble, France)

It is very important, from the point of view of both safety and economy, to detect losses from water-storage systems designed for irrigation or power production. An experiment is described which enabled the determination of the source of losses from an earth dam. The zones of infiltration were determined by injecting radioactive tracers in the lake at points or along lines, over distances of about 50 m. The radioactivity of the water was then checked at the outlet from the dam's drains, and curves were prepared showing the point at which the radioactive cloud reached the bottom of the water in the reservoir; this was done by using a nuclear probe lowered over the side of a boat whose position was plotted from the bank. The envelope of the curves obtained when activity is detected at the outlet of the drains defines the infiltration area of the lost water. A detailed explanation of the technique is given and the modifications which might be necessary to suit special situations which can arise are discussed. These consist of using tracers easily adsorbed on to the bottom of the stored water, the use of labelled sediments, and the injection of tracers through pierced tubes placed at the bottom of the reservoir. (Auth)

<440>

Gulyakin, I.V., Influence of Systematic Fertilization of Soils on the Accumulation of Radioisotopes in the Crops. 1963. *Izv. Timiryazev. Sel'skokhoz. Akad.*, 6, 138-150

Long systematic use of fertilizers affects the soil fixation of radioactive fission products and Co 60 as well as the accumulation of radioisotopes in crops. The systematic use of manure together with mineral fertilizers on limed soils increases the fixation of Sr 90, Cs 137, Ce 144, and Co 60 and significantly decreases the accumulation of these substances in oats. Long application of phosphate fertilizer decreases the Sr 90- content of oats; and the addition of potassium to the soil decreases greatly the plant content of Cs 137 and the content of the other radioisotopes to some extent. The amount of Co 60 in the plants is significantly increased by the use of nitrogen fertilizer, since long use of nitrogen fertilizers decreases the fixation of soil cobalt. (tr-Auth)

<441>

Gulyakin, I.V., I.E. Dergunov, and V.D. Moroz, Behavior of Radioactive Fission Products in Some Soils of the Sierozem Zone of Uzbekistan. 1968. *Izv. Timiryazev. Sel'skokhoz. Akad.*, 1, 84-93

Samples of sierozem and meadow soils (0.5 g) were treated with solutions (10 ml) containing 5×10^{-4} mCi of Sr 90, Cs 137, and Ce 144. Following determination of the residual activity of the samples, they were leached with solutions of CaCl₂, KCl, NaCl, NH₄Cl, and NaOAc, and with water (control). The salt solutions leached very little Ce 144 and practically all of the Sr 90. Large amounts of Cs 137 were leached with KCl and NH₄OAc. The adsorption of Sr 90 and Cs 137 was independent of the soil type and its salinity. They were most effectively removed from the soil by NH₄OAc. The addition of Sr in amounts up to 1000 mc/kg of soil had no effect on the adsorption of Sr 90, but large amounts

<441> CONT.

increased Sr 90 desorption. Cotton plants grown on previously leached typical sierozem developed normally. The Sr 90 uptake by these plants was half that of plants grown on water leached soils. (NSA)

<442>

Gulyakin, I.V., E.V. Yudinseva, and E.M. Levina, Effect of Soil Minerals on the Uptake of Strontium 90 by Plants. 1966, March. *Agrokimiya*, 3, 111-120 (Biophysical Laboratory, Moscow, USSR)

Experimental results showed that the type of soil formation, content of minerals and clays, and the content of minerals with different degrees of stability affects the binding of radiostrontium and at the same time reduces the uptake of this nuclide by plants. Clays of the Montmorillonite group of minerals, characterized by a high absorptive capacity because of the structure of the crystal lattice, adsorb radiostrontium very stably and sharply reduce its uptake in plants and accumulation in crops more effective than minerals of the hydromica group, mica, and kaolinite groups. The different effects on the uptake of Sr 90 in plants are representative of the individual micas and hydromicas. Vermiculite, hydrophilic opite, biopite, and phlogopite decrease the absorption of Sr 90 in plants although to a lesser degree than the clays of the Montmorillonite groups, and radiostrontium in oat crops. A slight effect on the uptake of Sr 90 is caused by kaolinite evidently because its absorption takes place only on the surface layers of the crystalline lattice. (tr-Auth)

<443>

Gulyakin, I.V., E.V. Yudinseva, and A.V. Korovkina, Effects of Soil Fractions on Uptake of Strontium 90 into Plants. 1965. *Izv. Timiryazev. Sel'skokhoz. Akad.*, 4, 36-47

The results of studies on the effects of different mechanical properties in soils on the uptake of strontium 90 by plants and its accumulation in crops indicate that of the soil components slime decreases the radiostrontium uptake and accumulation the most. The slime used in these tests contained calcium in the absorbed state and was very similar to the muddy fractions of natural soils. It strongly fixed the absorbed strontium 90 and by its effect with respect to the decrease of the accumulation of this radioisotope in the harvest approached that of natural soil. The slime fractions, from which the calcium was removed, also significantly decreased the accumulation of strontium 90 in the harvest. (tr-Auth)

<444>

Gulyakin, I.V., and E.V. Yudinseva, Radioactive Fission Products in Soil and Plants. 1962. Gosatomizdat, Moscow 276 p.

Plant uptake of fission products from soil and behavior of radioactive fission products in soil was investigated. Absorption and distribution of strontium and cesium in plants, influence of soil organic matter on mineral uptake, and experiments on soil decontamination are discussed. Effects of various radioactive products on growth and development of plants and retention of strontium and cesium in the edible parts of crop plants after foliar contamination are also considered. (NSA)

<445>

Gulyakin, I.V., and E.V. Yudinseva, Uptake of Strontium, Cesium and Some Other Fission Products by Plants and their Accumulation in Crops. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 476-488), 624 p.

Data from Russian experiments on the factors which affect the accumulation of strontium and cesium in plants are presented. (CWF)

<446>

Gulyakin, I.V., and E.V. Yudinseva, Uptake by Plants of Radioactive Fallout Products and on their Removal from Soil. 1957. *Izv. Timiryazev. Sel'skokhoz. Akad.*, 3, 81-108

Strontium 90 was taken up by plant from nutrient solutions in greater quantities than other fission products tested. The uptake from soil is considerably smaller than uptake from nutrient solutions. Radiostrontium uptake from lighter soils was greater than from heavier soils. Plants, especially legumes were found to "clean" the soil of radiostrontium. (CWF)

<447>

Gulyakin, I.V., and E.V. Yudinseva, The Effect on Plants and the Accumulation of the Products of Radioactive Fallout with Varying Distribution in the Soil. 1957. *Izv. Timiryazev. Sel'skokhoz. Akad.*, 3, 53-80

Plant uptake of radiostrontium was suggested as a means for decontamination of soil. (CWF)

<448>

Gulyakin, I.V., and E.V. Yudinseva, Effect of Lime, Humus, and Potassium Fertilizers on the Assimilation by Plants of Radioactive Fission Products and Their Accumulation in the Crop. 1957. *Izv. Timiryazev. Sel'skokhoz. Akad.*, 2, 121-140

Radiostrontium accumulation in plants was found to decrease on liming and applications of potassium fertilizers. Total uptake by legumes was decreased to a greater extent than that in cereals. Lime and potassium soil amendments did not effect the character of equilibrium of strontium 90 and yttrium 90 in various plant parts. (CWF)

<449>

Gulyakin, I.V., and E.V. Yudinseva, Effect of Organic Matter on the Accumulation of Fission Products in Crops. 1962. *Compost Science*, 2(4), 9-12

An article is taken from the Russian report "On the Behavior of Fission Products in Soil" on how lime and organic matter influenced the uptake of fission products in plants. The work shows that on large application of organic matter with and without amendments of lime the uptake of some of the fission products, especially strontium 90 is reduced. Organic matter application on a sandy loam soil showed a greater reduction in fission uptake than similar applications to a loamy soil. (CWF)

<450>

Gulyakin, I.V., E.V. Yudinseva, and E.M. Levina, The Effect of Stable Strontium on the Strontium

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<450> CONT.

90 Uptake by Plants. 1961. Izv. Timiryazev. Sel'skokhoz Akad., 6, 97-109

The article deals with tests, their results and their influence on the studies of stable strontium and the effects of radiostrontium in plants depending upon the portion of stable strontium, the quality of soils and the biological properties of plants. (CWF)

<451>

Gulyakin, I.V., E.V. Yudinseva, and K.I. Makarovich, Accumulation of Strontium 90 in Wheat on Sod-Podzolic Soils. 1971. Agrokhimya, 4, 84-92

Thirty-two sod-podzolic soils were investigated. A close relation was observed between the Sr 90 accumulation in wheat and the quantity of exchangeable Ca in the soil, degree of the soil radionuclide stability, and the Sr 90 content in the plants at early developmental stages. The soil Ca/Sr relation was altered by the soil acidity and the amount of humus. (NSA)

<452>

Gulyakin, I.V., and E.V. Yudinseva, The Entry of Fission Products into Plants and their Effect on the Plant Organism. 1956. Izv. Timiryazev, Sel'skokhoz. Akad., 3, 121-142

Wheat plants exposed to radioactive cerium and cesium showed less content of protein nitrogen in the leaves at tillering than non-exposed plants. Data also indicated an increase in content of reducing sugars in the leaves of wheat. (CWF)

<453>

Gulyakin, I.V., E.V. Yudinseva, and E.M. Levina, Effect of Clay Minerals on Content of Strontium 90 in Oats. 1967. Izv. Timiryazev. Sel'skokhoz. Akad., 1, 77-84

The afteraction of lower doses (30 g) and the effect of higher doses (60 and 100 g) of minerals on the availability of radiostrontium to plants have been studied. Montmorillonite, askanite, bentonite, gumbarine, and kil, belonging to the montmorillonite group of minerals and clays reduce the radiostrontium supply to plants and its accumulation in the crop much more than minerals of the groups of micas, hydromicas, sesquioxides and especially those of the kaolinite group do. Different micas and hydromicas produce different effects on Sr 90 supply to plants. Vermiculite, hydroflogopite glauconite, flogopite and biotite reduce the accumulation of radiostrontium in plants, though not so much as clays and minerals of montmorillonite group, but muscovite and dawsonite do not practically reduce the content of Sr 90 in oats crop, which seems to be due to the difference in their crystal-chemical characters. (Auth)

<454>

Gunn, K.B., and K.B. Mistry, The Effect of Chelation Agents on the Absorption of Radium by Plants. 1970. Plant and Soil, 33, 7-16 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

The absorption of radium from solution, by plants, has been compared with that of calcium, active strontium being used as a label for the calcium. It was found that radium was preferentially retained by the

roots and discriminated against in passage to the shoots. However, the uptake and distribution of radium was influenced by ethylenediaminetetra acetic acid and citrate at the concentrations employed in water culture media to keep iron in solution. (Auth) (CWF)

<455>

Gunther, J., and D. Schroeder, Influence of Soil Properties on the Uptake of Radioactive Strontium by Plants. II. Greenhouse Experiments with White Clover on Model Soils with Systematically Varied Properties. 1968. Z. Pflanzenernaehr. Bodenk., 120, 78-85 (University of Kiel, Institute fur Pflanzenernaehrung und Bodenkunde, Kiel, German Federal Republic)

The influence of soil properties, Ca content, pH, exchange capacity, and content of clay and organic matter on the uptake of radioactive strontium by white clover was investigated in pot experiments. 15 samples of a slightly acid brown earth were altered with respect to their Ca content and pH with H₂SO₄, NaOH and CaCl₂. The exchange capacity and content of clay and organic matter of 12 samples were changed by mixing varying portions of clay, peat, and sand. Carrier free radioactive Sr 89 was mixed to all samples and was determined together with the Ca contents in soils and plants after the experiment. The Sr content and the Sr/Ca quotient of clover was found to be decreased by higher Ca content, pH, content of clay, and exchange capacity. With very high Ca contents, the water soluble calcium amounting to more than 10 percent of the exchangeable, the Sr contents in the plants increase although the Sr/Ca quotients decrease. The Sr/Ca discrimination factors ($DF = \text{Sr plant/Sr soil} \times \text{Ca plant/Ca soil}$) were lowered by increasing pH and clay content. Sr contents, Sr/Ca quotients of the plants and discrimination factors were not found to be significantly influenced by organic matter. (tr-Auth)

<456>

Gunther, J., and D. Schroeder, Effect of Soil Properties on the Uptake of Radioactive Strontium by Plants. I. Investigation with White Clover and Ryegrass on Schleswig-Holstein Soils. 1968. Z. Pflanzenernaehr. Bodenk., 119, 216-227 (University of Kiel, Institute fur Pflanzenernaehrung und Bodenkunde, Kiel, German Federal Republic)

The influence of soil properties on the uptake of radioactive strontium by white clover and ryegrass was investigated in pot experiments. 11 samples of Schleswig-Holstein soils, free of carbonate and varying considerably with respect to Ca content, pH, exchange capacity, clay content, and organic matter were used. The Sr content of the plants was most decreased by higher Ca content, followed by clay content and exchange capacity of the soils. No significant influence of pH and organic matter was detectable. Sr/Ca quotients of the plants were also largely determined by Ca contents of the soils. The Sr/Ca discrimination factors ($DF = \text{Sr plant/Sr soil} \times \text{Ca soil/Ca plant}$) were lowered by increasing amounts of exchangeable calcium in the soil, indicating a preferential uptake of calcium under these conditions. Sr/Ca quotients and discrimination factors were not found to be influenced significantly by the other soil properties considered here. As expected, white clover contained more strontium than ryegrass, since the content of alkaline earth elements in legumes is higher than in grass. However for the different plant

<456> CONT.

species, variations of Sr uptake were found to be uniformly affected by the properties of the soil substrate. (tr-Auth)

<457>

Gustafson, P.F., Ratio of Cesium 137 and Strontium 90 Radioactivity in Soil. 1959. Science, 130, 1404-1405 (Argonne National Laboratory, Argonne, IL)

The similarity in genesis and the more pertinent physical characteristics of fission-produced Cs 137 and Sr 90 suggests the use of the first as a convenient monitor for the other prior to uptake in the biosphere. Results are presented which indicate the feasibility of this approach in the case of soils. (Auth)

<458>

Haak, E., and A. Eriksson, Studies on Plant Accumulation of Fission Products under Swedish Conditions. XV. Uptake of Cesium 137 by Wheat as Influenced by Type and Rate of Nitrogen Fertilization under Field Conditions. 1973, October. FOA-4-C-4559-A3; 25 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The influence of N-fertilization on the uptake of Cs 137 by wheat was studied for four years in a micro plot experiment with two clay and one sandy soil, all on a sandy subsoil. Calcium nitrate, ammonium nitrate and urea were applied to the seedbed yearly at three rates. The soil quality of the plough layer mainly determined the uptake of Cs 137 by the wheat crop. It was found that the Cs 137 concentration in the plant was several times higher on the sandy soil than on the clay soils. It varied considerably from year to year on all the three soils, most certainly depending on the differences in the root activities in the soil profile caused by different amounts and distribution of precipitation during the growth periods. Because of this variation, continued cropping is needed for a reliable determination of the changes in the plant availability of Cs 137 under field conditions. The N-type and the N-rate influenced the Cs 137 uptake and was of practical significance on the sandy soil. On this soil the Cs 137 concentration in the plant increased with the N-rate and was usually higher for ammonium nitrate and urea than for calcium nitrate. The Cs 137 concentration was usually much lower in the grain than in the straw but the difference varied between soils and between years. (Auth)

<459>

Haak, E., and A. Eriksson, Studies on Plant Accumulation of Fission Products under Swedish Conditions. XIV. Uptake of Cesium 137 by Wheat and Timothy from Six Different Soils as Influenced by Rate of Potassium Fertilization and by Type and Rate of Nitrogen Fertilization in Pot Experiments. 1973, October. FOA-4-C-4557-A3; 37 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The influence of K- and N-fertilization on the uptake of Cs 137 by wheat and timothy was studied in pot experiments with 6 soils of different texture and potassium status. Three rates of K- application were combined with three types of N-fertilizer - calcium nitrate, ammonium nitrate and urea - each of which was applied at three rates. The effect of prolonged cropping was studied. It was found that the soil quality and the uptake of K

mainly determined the uptake of Cs 137 at low K- and N-rates. The concentration of Cs 137 in the crops was highly negatively related to the contents of clay and K sub AL. K-fertilization reduced the uptake of Cs 137 considerably. This effect decreased, however, with increased contents of clay and K sub AL. The effect of N-fertilization was dependent on the types of N-fertilizer, N-rate and K-level. While increased application of calcium nitrate slightly decreased the Cs 137-content in the plant, increased application of ammonium nitrate or urea highly increased it. Both effects decreased with increased K-rate and with increased contents of clay and K sub AL in the soil. Prolonged cropping resulted in higher Cs 137-content in the plant on soils with low contents of clay and K sub AL, while the reverse was the case on soils with high contents of clay and K sub AL. (Auth)

<460>

Haak, E., A. Eriksson, and F. Karlstrom, Studies on Plant Accumulation of Fission Products under Swedish Conditions. XIII. Entry of Strontium 90 and Cesium 137 into the Herbage of Contrasting Types of Pasture. 1973, January. FOA-4-C-4525-A3; 44 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

The entry of Sr 90 and Cs 137 from simulated single depositions into the herbage of pasture has been studied in a long term field experiment for six years at two different sites. One field was located on permanent natural pasture on an acid sandy soil and the other on a grazing ley of long duration on a neutral clay soil. At both these fields fertilizer experiments had been running for 11 years in advance. The distribution of activity in the soil profile was studied at the end of the experimental period. The entry of Sr 90 into herbage was greater than the entry of Cs 137 at both sites already in the first cut after contamination. It declined more for Cs 137 than for Sr 90 in the successive cuts this year, and relatively more on the grazing ley than on the permanent pasture. In the following it decreased from year to year for both nuclides. The mean Sr 90/Ca ratio was about four times higher on the permanent pasture than on the grazing ley, while the mean content of Cs 137 per unit dry matter was about ten times higher on the former than on the latter. (Auth)

<461>

Haekkinen, U., and E. Lakanen, Strontium 90 and Cesium 137 in Some Finnish Soil Profiles. 1968. Ann. Agr. Fenn., Ser. Agrogeol., Chim. Phys., 7, 123-126 (Agricultural Research Center, Tikkurila, Finland)

The amounts of Sr 90 and Cs 137 in five undisturbed Finnish soils in 1965 were 26 to 48 and 56 to 103 $\mu\text{Ci}/\text{km}^2$ (means 39 and 75, respectively). The corresponding medium depths for 50 percent leaching were 4.2 and 2.1 cm, which is caused by the low annual rainfall and freezing of soils in winter. (Auth)

<462>

Haeussermann, W., and H. Schreiber, Investigations of the Strontium 90 Contents in Soils. 1967, July. Atompraxis, 13, 303-306 (Landwirtschaftliche Hochschule, Stuttgart, German Federal Republic)

The results of more than 200 determinations of the Strontium 90 contents in soils during 1960 to 1964 down to 20 cm in depth are given. The

<462> CONT.

annual amount of precipitation on the different collection places across the Black Forest ranges from 780 to 2200 mm. The variations in time of the Strontium 90 activity and the distribution in depth are discussed. (tr-Auth)

<463>

Haghiri, F., Detailed Characterization of Soil and Vegetation on Selected Sites to Serve as Basis for Future Evaluation of Effect of Radioactive Contamination, Technical Progress Report, March 1, 1969 - November 26, 1969. 1969. COO-414-13: 73 p. (Ohio Agricultural Research and Development Center, Wooster, OH)

The movement of Sr 90 in the soil profile and the removal of Sr 90 by runoff, leachate, and plants uptake as influenced by soil and crop management practices are presented. Over a 7 year period, the net rate of Sr 90 loss from 0 to 4 inch depth by various processes was maximum under gravel mulch and minimum under permanent grass cropping systems. The distribution of Sr 90 in the top 12 inches of soil profile was influenced by cropping system and liming. The concentration of Sr 90 at 3 to 12 inch depth under gravel mulch was approximately 10 times higher than permanent grass system. The application of high rates of lime reduced the downward movement of Sr 90. The percent of the initial application of Sr 90 removed by runoff decreased while its loss by leachate increased during the 7 year period. The distribution of Sr 90 in various parts of the winter wheat plant during 1968 to 1969 was 65% in straw, 27% in chaff, and 8% in grain. The distribution of Sr 90 in corn fodder was 99% while in shelled corn it was 1% of the total Sr 90 taken up by the corn plant. The total percent Sr 90 removed by runoff, leachate, and plant uptake after a 7 year period was 16.407, 13.655, 12.481, 10.828, and 9.231 for gravel mulch, rotation a (low lime), continuous corn, rotation b (high lime), and permanent grass respectively. The effects of various rates of fenac, benzac, trifluralin, CIPC, Pyramin, and diquat herbicides on the absorption of Sr 90 by soil were studied. Among these herbicides, diquat was the most effect in releasing from soil or reducing the adsorption of Sr 90 by soil. Its effect was more pronounced under low than high pH soil. High rates of lime had a depressing effect on the removal of Sr 90-Y 90 by leaching with water in the presence of paraquat herbicide. Paraquat appears to be most effective in replacing strontium ion in acid soils with low clay and low organic matter contents. The two soils (Dunbar and Lynchburg), furnished by the USDA, were treated with Sr(+2) and the retention of Sr(+2) was compared to other soils. The curves for the adsorption and displacement of Sr 90 was similar to the soils used in previous experiments and reported in earlier reports. The non-displaceable Sr was approximately 30% of the total adsorbed. Soil samples were analyzed for boron content after the samples were methylated at various rates of BF₃-MeOH. The boron content of the samples increased with increasing rates of BF₃. Therefore, methylation of soil organic matter with the BF₃ method is of a limited value in soil's work. It would be of value in soil organic matter fractions that contain compounds that are not reactive with BF₃, for example fatty acids. The sample of runoff water from micro-plots was electro-dialyzed and Sr 90 was detected in the anode chamber. The sample is being fractionated for IR and gas chromatographic analyses. The distribution of Sr 90 from soybean and corn tissue in soil columns was determined. The least movement

was in the muck soil column and the most movement in the Wooster soil column. There were no conclusive differences between the tissues. (Auth)

<464>

Haghiri, F., Effects of Soil and Crop Management Practices on the Removal of Strontium 90 by Plant Uptake, Leaching, Runoff and Erosion. 1969. Agronomy Journal, 61, 793-797 (Ohio Agricultural Research and Development Center, Department of Agronomy, Wooster, OH)

Long-term field investigations are being conducted to study the effect of management practices on the removal of Sr 90 by runoff, leaching, erosion and plant uptake. The management practices consist of one crop rotation with high and low rates of lime, permanent grass, continuous corn, and gravel mulch with no vegetation. Over a 5-year period, the Sr 90 content of the soil in a 0-10 cm depth decreased in all cropping systems. The percent Sr 90 loss by runoff water and sediment was negatively correlated with time while the percent Sr 90 in the leachate water increased with time. The percent Sr 90 removal by runoff and leachate water was maximum under gravel mulch and minimum under grass treatments. Sod crops were more effective in minimizing the Sr 90 loss in runoff and leachate water than cultivated crops. High Ca accumulating crops such as alfalfa removed more Sr 90 than low accumulators such as corn. High rates of lime reduced the Sr 90 uptake by crops and the removal by leachate water. (Auth)

<465>

Haghiri, F., Strontium 90, Zirconium 95, and Cesium 137 Accumulation in Corn Plants as Influenced by Soil Temperature. 1962. Agronomy Journal, 54, 278-279 (Ohio Agricultural Experiment Station, Department of Agronomy, Wooster, OH)

The accumulation of Sr 90, Zr 95, and Cs 137 by young corn plants as influenced by soil temperature was studied in greenhouse experiments. Soil temperature had a significant influence upon the accumulation of Sr 90 and Cs 137 by 3-week-old corn plants, with highest levels occurring at 70 degrees Fahrenheit. No measurable uptake of Zr 95 was found at any soil temperature. (Auth)

<466>

Haghiri, F., Fate of Strontium 90 in Soil, Plants and Water. 1970. Ohio Report, 55, 74-77 (Ohio Agricultural Research and Development Center, Department of Agronomy, Wooster, OH)

Soil management factors were shown to be very important to the manner in which the movement of radiostrontium occurred in soils. (CWF)

<467>

Haghiri, F., and J.D. Sayer, Strontium Uptake by Plants as Influenced by Soil Types and Liming. 1961. Soil Science Society of America Proceedings, 25, 120-123 (Ohio Agricultural Experiment Station, Department of Agronomy, Wooster, OH)

A greenhouse study was conducted to determine the influence of various soil types and liming on the uptake of Sr 90 by plants. There were highly significant differences in the total uptake and concentration of Sr 90 by corn, soybeans, buckwheat, Sudangrass, and alfalfa from different soil types and liming. In

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general, the total uptake of Sr 90 from acid Ashtabula, Miami, and Canfield soils was considerably higher than the total uptake from slightly acid Brookston soil. Liming depressed the total uptake of Sr 90 by the plants grown on the acid Ashtabula, Miami, and Canfield soils; but had no effect on the total Sr 90 uptake by the plants from Brookston soil. These differences appear to be associated partly with the differences in exchangeable calcium and pH of the soils. The accumulation of radiostrontium by the various plant species after 5 weeks of growth was in the order: Buckwheat > soybeans > alfalfa > Sudangrass = corn. (Auth)

<468>

Hajek, B.F., Dispersion Characteristics of Strontium in Soil Columns. 1966. BNWL-235-3; (p. 44-47) (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Dispersion experiments were conducted with strontium in soil columns. A mathematical model was compared to the experimental data and was found to predict adequately the strontium distribution in soil columns. (Auth)

<469>

Hajek, B.F., Adsorption, Migration, and Dispersion of Strontium and Cesium in an N-Area Soil. 1965. BNWL-CC-208; 20 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Experimental and mathematically derived results are presented which characterize the adsorption, migration and dispersion in an N-Area soil of strontium and cesium present in a simulated emergency waste water. The experimental results from laboratory soil columns and equilibrium studies showed that the soil at the proposed disposal site is more selective for cesium than strontium. The distribution coefficients were 420 and 43 ml/q for cesium and strontium respectively. Extrapolation of column breakthrough data showed that 42 and 12 column volumes of influent were required for 0.01 percent breakthrough for cesium and strontium respectively. Calculations based on theoretical equations and equilibrium distribution coefficients indicated that the average migration rate of cesium through a soil column should be 1/10 the rate of strontium. The actual migration rate of cesium through the column was 1/11 of strontium rate. Migration rates in ground water were determined relative to ground water movement: Migration rate of Sr = 1/100 rate of ground water movement, migration rate of Cs = 1/1000 rate of ground water movement. Diffusion coefficients determined for strontium and cesium in soil material indicate that spreading of these adsorbed radionuclides by this mechanism is negligible. The average infiltration rate was determined to be 170 qpd/ft². (Auth)

<470>

Hajek, B.F., Dispersion Characteristics of Strontium in Soil Columns: Partially Saturated Transient Flow. BNWL-481-3; (p. 39-42) (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

An experiment for determining the migration and dispersion characteristics of strontium ions invading soil in two partially saturated transient systems is described. Porous soil was packed into a tray and a solution of 0.1 M

Sr(NO₃)₂ traced with Sr 85 introduced. The quantity of wetting solution and position of the wetting front were recorded, the flow stopped, and the soil samples analyzed for moisture and strontium content. It was concluded that no model could be successfully used to predict Sr dispersion in soils, and that the solution flow rate had little effect on the Sr dispersion at equivalent distances migrated. (NSA)

<471>

Hajek, B.F., Plutonium and Americium Mobility in Soils. 1966, November. BNWL-CC-925; 9 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

The fraction of soil Pu which can be readily moved by an invading solution, soil alpha activity movement by diffusion and Am leaching characteristics in soil were determined. Diffusion and leaching experiments show that only a small amount of Pu is mobile. About 0.1 percent of the Pu can be leached by invading ground water; the leach rate is slow and Pu migration after leaching into lower soil layers is approximately 10 E+4 times less than the transporting solution velocity. Movement is negligible in a 10 yr period. A larger fraction of Am, approximately 7.5 percent, is leached by ground water. Alpha activity distribution coefficients between soil and groundwater are greater than 10 E+4 ml/q, indicating that the ratio of solution movement to alpha activity movement also will be of this magnitude. (NSA)

<472>

Hajek, B.F., Trace Strontium Adsorption in a Partially Saturated Transient System. BNWL-715; p. 50-56 (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

The results of a study on the movement of trace quantities of strontium in a sodium solution invading dry soil are presented. (Auth)

<473>

Hajek, B.F., and L.L. Ames, Jr., Trace Strontium and Cesium Distribution Coefficients: Batch and Column Determinations. 1966. BNWL-SA-843 (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Equilibrium distribution coefficients for strontium and cesium were determined by batch and small column techniques. The results showed that in batch methods the solution: soil ratio used can significantly affect the distribution coefficient in some systems. The effect was especially evident for trace cesium in ground water. Volume effects were also noted in sand, silt, and clay fractions. Equilibrium distribution coefficients determined by use of small columns should eliminate volume effects. However, the entire loading curve should be studied as secondary reaction may cause some desorption during through-put and the maximum sorption may not represent the equilibrium amount. (Auth)

<474>

Bakonson, T.E., and L.J. Johnson, Distribution of Environmental Plutonium in the Trinity Site Ecosystem After 27 Years. 1973. CONF-730907-14; 7 p. (Los Alamos Scientific Laboratory, Los Alamos, NM)

The results are presented for a radioecological survey of the Trinity Site

<474> CONT.

environs, where the world's first (July 1945) atomic bomb was detonated. The temporal behavior of the low environmental levels of the plutonium produced by this detonation are discussed. The data from this study were compared with similar data obtained in the Trinity Site environs nearly 20 years ago. The major change which was observed was an increased migration of Pu into the soils. Concentrations of Pu in vegetation and rodents were too low to make valid comparisons. (Auth)

<475>

Hale, V.O., and A. Wallace, Effect of Chelates on Uptake of Some Heavy Metal Radionuclides from Soil by Bush Beans. 1970. Soil Science, 109, 262-263 (University of California, Department of Agricultural Sciences, Los Angeles, CA)

Several chelating agents were investigated to find their effect on enhancing plant uptake of heavy metals from soil. DTPA increased the plant uptake of Pb 210 and Am 241 in bush beans from two soils. EDDHA increased the uptake of Sb 125 and Am 241 from both soils. (CWF)

<476>

Halstead, E.H., S.A. Barber, D.D. Warncke, and J.B. Bole, Supply of Calcium, Strontium, Manganese, and Zinc to Plant Roots Growing in Soil. 1968. Soil Science Society of America Proceedings, 32, 69-72 (Purdue University, Agriculture Experiment Station, Lafayette, IN)

The influence of four soils and two transpiration rates on the amounts of Ca, Sr, Mn, and Zn supplied to the root by root interception, mass-flow and diffusion and on the uptake of these ions by four plant species was investigated in a growth chamber experiment. The relation between the calculated supply to the root by root-interception plus mass-flow and the uptake of Ca and Sr was different for each species but was not affected by soil or transpiration rate. The relation between supply of Mn and Zn and uptake was not affected by plant species. The relation of the uptake of Mn was highly correlated with supply by root interception plus mass-flow over a very wide range of values. The correlation observed between Zn uptake and the supply by root interception plus mass-flow was lower than for Ca, Sr, or Mn because considerable quantities of Zn also reached the root by diffusion. Three methods of calculating the quantity of root interception were evaluated by determining the relative degree of correlation between the calculated supply and uptake by the plant. The method which estimates the maximum possible root interception gave the highest correlation. The use of a parameter based on root area was very poorly correlated with uptake. (Auth)

<477>

Hamid, A., and B.P. Warkentin, Retention of Iodine 131 Used as Tracer in Water-Movement Studies. 1967, October. Soil Science, 104, 279-282 (McGill University, Montreal, Canada)

Iodine 131 retention in marine-deposited clay soils was evaluated. Adsorption was measured with different competing anions at different salt concentrations and at varying pH values. The I 131 was assayed for gamma radiation with a spectrometer using a solid NaI crystal scintillator. Keeping the pH value above 7 or the addition of stable iodide salt prevents

the adsorption of I 131 on the clay particles. The I 131 can be used as a tracer in acid soils only in the presence of stable I carrier. (NSA)

<478>

Handley, R., and K.L. Babcock, Translocation of Carrier-Free Strontium 85, Cesium 137, and Ruthenium 106 in Woody Plants. 1970. Radiation Botany, 10, 577-583 (University of California, Department of Soils and Plant Nutrition, Berkeley, CA)

Carrier-free solutions of Cs 137 and Ru 106 were applied to the foliage of three genera of woody shrubs (Ceanothus, Adenostoma, and Quercus) and subsequent translocation into untreated portions of the plants was measured. In all cases the bulk of the retained dose remained with the directly treated material. The results indicate that in these genera foliarly applied Cs 137 is no more mobile than Sr while Ru 106 is considerably less mobile than either. In Ru 106 series of experiments the distribution of Sr 85, Cs 137, and Ru 106 between the root, the old growth and the new growth was determined after incorporation of the isotopes into Ceanothus and Adenostoma via their root systems. Cs 137 and especially Ru 106 were largely retained in the root. A relatively large fraction of the retained dose of Sr 85 was found in the shoot. In both series of experiments a preferential movement of Cs 137 into new growth was observed. (Auth)

<479>

Handley, R., and K.L. Babcock, Translocation of Strontium 85, Cesium 137, and Ruthenium 106 in Crop Plants. 1972. Radiation Botany, 12, 113-119 (University of California, Department of Soils and Plant Nutrition, Berkeley, CA)

The distribution of Sr 85, Cs 137, and Ru 106 between the root, the old growth and the new growth of bean, tomato, and corn was determined after incorporation of the isotopes into the plants via the roots. The results are compared with those obtained earlier in similar experiments using the xerophytic shrubs, CEANOTHUS and ADENOSTOMA. As in the latter plants, almost all of the Ru 106 taken up by the crop plants was retained by the roots. Root retention of Sr 85 and Cs 137 was, however, much less in the crop plants. With respect to movement within the shoot (from old growth to new growth), Cs 137 was found in the crop plants as in the shrubs to be more mobile than Sr 85. The difference in mobility was more pronounced in the crop plants. It is suggested that the relatively high mobility of foliarly applied Sr 85 found in the xerophytic shrubs may be related to their low transpiration rates. The low mobility of foliarly applied Cs 137 in these plants is ascribed to adsorption on or within the leaf cuticle. (Auth)

<480>

Handley, R., R.L. Babcock, M.H. El-Sayed, B.G. Buxac, R.K. Schulz, N. Balzar, and A.D. Kantz, Behavior and Effects of Radionuclides in Soils and Plants, Three Year Summary, 1971-73. 1973. TID-26433; 12 p. (University of California, Berkeley, CA)

Presented is a summary of work relating to radiation effects in plants, uptake of carrier-free Cs 137 and Sr 85, uptake and translocation of Sr 85, Cs 137, and Ru 106 in ZEA MAYS and radiation damage to field crops. (CWF)

<481>

Handley, R., and R. Overstreet, Uptake of Calcium and Chlorine in Roots of ZEA MAYS. 1961. Plant Physiology, 36, 766-769 (University of California, College of Agriculture, Berkeley, CA)

The uptake of calcium and chloride in vacuolated sections of the primary roots of ZEA MAYS was strongly temperature dependent, thus largely metabolic. (CWF)

<482>

Handley, R., and R. Overstreet, Uptake of Strontium by Roots of ZEA MAYS. 1963. Plant Physiology, 38, 180-184 (University of California, Department of Soils and Plant Nutrition, Berkeley, CA)

Plant uptake by the primary roots of maize seedlings (ZEA MAYS) showed uptake of strontium was similar to Na, Ca, and Cl in the meristematic portion of the root tip, viz, controlled by non-metabolic processes, but in the vacuolated tissue uptake was controlled by metabolic processes. The authors indicated the existence of a barrier in the proximity of the cell surface which limits non-metabolic uptake of strontium. (CWF)

<483>

Handley, R., and R. Overstreet, Effect of Various Cations Upon Absorption of Carrier-Free Cesium. 1961. Plant Physiology, 36, 66-69 (University of California, Department of Soils and Plant Nutrition, Berkeley, CA)

The effects of the monovalent cations K, Na, NH₄, Rb, Li, and Cs and of the divalent cations Ca, Mg, and Ba upon the absorption of carrier-free Cs 137 by excised barley roots has been investigated. In the concentration range of 0 to 0.10 mequiv per liter Na, Li, Ca, Ba, and Mg had essentially no depressant effect upon Cs 137 uptake whereas K, Rb, NH₄, and Cs were markedly effective. At higher concentrations all ions investigated inhibited the absorption of Cs 137. The uptake of carrier-free Cs 137 was found to be strongly temperature dependent and is therefore largely the result of metabolic absorption rather than of diffusion and adsorption phenomena. In spite of this the behavior of the ions studied in inhibiting uptake of Cs 137 parallels their behavior in respect to competition for exchange sites upon soil colloids. A possible reason for this is discussed. (Auth)

<484>

Handley, R., R.K. Schulz, H. Marschner, R. Overstreet, and W.M. Longhurst, Translocation of Carrier-Free Strontium 85 Applied to the Foliage of Woody Plants. 1967. Radiation Botany, 7, 91-95 (University of California, Department of Soils and Plant Nutrition, Berkeley, CA)

Carrier-free Sr 85 was applied to the foliage of three genera of woody forage plants (CEANOTHUS, ADENOSTOMA and QUERCUS) and subsequent translocation into untreated portions of the plants was measured. Experiments were conducted in the field and in the greenhouse. In all cases the bulk of the retained dose remained with the directly treated material. However, substantial concentrations of Sr 85 were found in the new growth arising on previously treated branches of CEANOTHUS and ADENOSTOMA. The amounts translocated under field conditions under which plants were subject to periodic wetting and drying were greater than those translocated by plants in the greenhouse. (Auth)

<485>

Handreck, K.A., and D.S. Riceman, Cobalt Distribution in Several Pasture Species Grown in Culture Solutions. 1969. Aust. J. Agr. Res., 20, 213-26 (Commonwealth Scientific and Industrial Research Organization, Adelaide, Australia)

Lucerne (MEDICAGO SATIVA cv. Hunger River), subterranean clover (TRIPOLIUM SUBTERRANEUM L. cv. Bacchus Marsh), prairie grass (BRONUS CATHARTICUS Vahl), PHALARIS TUBEROSA, and evening primrose (OENOTHERA sp.) were grown in culture solutions containing Co 60. The distribution of cobalt in the tops was determined with autoradiographs of pressed, rapidly dried plants and by measuring the total amounts of Co 60 in pieces of fresh leaves dissected immediately after harvesting. Cobalt concentrations in the margins of lucerne, clover, and primrose leaves and at the base and extreme tip of the primrose and grass leaves were many times those found in other parts of the leaves. Cobalt accumulated at cut and cropped ends of leaves. Leaching removed up to 75 percent of the cobalt from dried leaves but none from fresh leaves. The concentration of cobalt in a given lucerne leaf reached a maximum soon after emergence and then declined rapidly as the leaf expanded. (NSA)

<486>

Hansen, R.O., Radioactivity of a California Terrace. 1970, July. Soil Science, 110, 31-36 (University of California, Davis, CA)

The radioactivity per unit area and depth of a California terrace soil was calculated. This is of use when assaying background activities or surveying radioactivities with detectors above the soil surface or in airplanes. When freed from minerals by weathering, uranium is leached more rapidly than is thorium, although thorium also shows evidence of movement. The degree of loss of uranium versus Th 230 is calculated and knowing the age of the sedimentary deposit, the rate of loss of uranium was estimated. Determinations of thorium by two independent means (alpha and gamma spectrometry), show reasonable agreement. Ra 226 activities were close to those of Th 230 as might be expected. (Auth)

<487>

Hansen, R.O., Isotopic Distribution of Uranium and Thorium in Soils Weathered from Granite and Alluvium. 1965. Ph.D. Thesis; 135 p. (University of California, Berkeley, CA)

Chemical techniques and physical instrumentation were developed to measure quantitatively the radioactivities of U 234, U 238, Th 230, and Th 232 in air-dry powdered samples of soils and rocks. These alpha emitters were measured by alpha particles spectrometry with ionization chambers and associated electronics constructed for these experiments. In residual soils of the Sierra Nevada, both uranium and thorium were concentrated to a greater degree than in the underlying rocks. Both uranium and thorium were most highly concentrated in clay fractions. Th 230 had redistribution patterns different from those of U 238, U 234, or Th 232 and often somewhat between those of isotopes of uranium and those of Th 232, showing the effects of Th 230 having existed as U 234 a significant fraction of the soil-forming period of time. Uranium 234 and U 238 usually had similar radioactivities.

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Curie radioactivity levels of individual nuclides ranged from 0.23×10^{12} (E-12) Ci/gram for a fresh rock sample to 3.2×10^{12} (E-12) curies/gram for a clay formed from the rock in the case of U 233 and U 234. In the residual upland soils studied, uranium was preferentially retained whereas in the alluvial soils thorium was preferentially retained. Lime concretions from Dugor type soils showed enrichment of uranium in excess of thorium. Ages of 40,000 to over 180,000 years were calculated by means of two equations, one based upon the rapid initial accumulation of uranium and the other based upon a constant rate of accumulation of uranium. For an estimate of age for a primary soil (Ahwahnee sandy loam) with a developed "B" horizon, an equation was developed analogous to a branched decay where one branch represented leaching loss and another radioactive decay. An age of 32,000 years was calculated for the topsoil. (NSA)

<488>

Hansen, R.O., and G.L. Huntington, Thorium Movements in Moraine Soils of the High Sierra, California. 1969, October. Soil Science, 108, 257-265 (University of California, Davis, CA)

Thorium distributions in a sequence of moraine soils in Bench Valley, California, were determined by gamma spectrometry of profile samples. Concentrations of thorium ranged from 10.8 ppm in a B2h horizon, to 24.0 ppm in a B21r horizon. The data indicate distinct thorium accumulation in horizons immediately underlying horizons of high organic content. A2 or B21r horizons respectively contained higher thorium concentrations when overlain by A1 or B2h horizons. Soil organic matter apparently complexed with thorium as well as with iron, although the leached iron accumulated visibly in horizons of pH 5.5 or greater, whereas thorium distributions were more diffuse and apparently less affected by change in pH. Radium was distributed (0.85 to 1.91 picograms/g) more irregularly than was thorium reflecting the effects of the soil chemistry of U 238, U 234, Th 230, as well as Ra 226, with the passage of time. Radium distributions are explained in terms of uranium retention by organic matter, mobilization of Th 230 by organic matter, plant absorption of radium, and time. Potassium concentrations ranged from 1.9 to 4.8 percent, being generally higher in A2 horizons than in A1 horizons (NSA)

<489>

Hansen, R.O., and P.R. Stout, Isotopic Distributions of Uranium and Thorium in Soils. 1968. Soil Science, 105, 44-50 (University of California, Kearney Foundation of Soil Science, Davis, CA)

Both uranium and thorium tend to concentrate as a result of rock weathering. Uranium and thorium losses from soils occur, but differential leaching favors uranium in one instance and thorium in another. Thorium concentrations are higher than uranium in the B horizons, but in the upper horizons of the upland primary soils uranium concentrations increase. The alluvial soils of the San Joaquin Valley tend to have higher and more evenly distributed concentrations of thorium. There are instances where U and Th become separated as a result of soil-forming processes, such as movement of uranium into lime nodules with calcium, or thorium from topsoils where the organic content is highest.

In these instances measurements of decay and of accumulations of Th 230 can give clues to the rates of soil-forming processes and for determining the ages of soil fractions. Isotopic analyses of uranium and thorium by alpha particle spectrometry appears to be a useful means of acquiring information about the mechanisms and rates of soil formation. (Auth)

<490>

Hansen, W.G., J.E. Campbell, J.H. Fooks, H.C. Mitchell, and C.H. Eller, Farming Practices and Concentrations of Fission Products in Milk. 1965. Public Health Service Publication, Environmental Health Series, Radiological Health, 35 p. (St. Louis County Health Department, St. Louis, MO; U.S. Public Health Service, Washington, DC)

Studies conducted over a 3-year period have shown that levels of strontium 90 and iodine 131 in milk can be moderated by optimal fertilization of the land. In controlled experiments, milk from cows grazing on abundant, well-fertilized pastures contained 50 percent or less of these radionuclides than did milk from cows grazing on unfertilized pastures on the same farm. A mechanism of dilution of the fission-product contamination in the larger volume of faster growing fertilized forage was shown to account for the differences in the milk. The findings suggest one possible means of controlling fission-product contamination in milk, if such control measures should be necessary. The results indicate that the high levels of strontium 90 in the St. Louis raw milk samples may have been due more to marginal fertilization of the farms than to uneven deposition of fallout. (Auth)

<491>

Hansen, W.R., Polonium 210 in Soils and Plants. 1970. Ph.D. Thesis; COO-1733-11; 142 p. (Colorado State University, Fort Collins, CO)

Polonium 210 used as a radionuclide fuel for SNAP electrical generators may present a long term hazard if accidental release of the isotope were to contaminate agricultural soils. Absorption of Po 210 Po2 in soils studied by bulk determination of distribution coefficients ($K_{sub d}$) indicated retention in the top soil samples was with silt content. Greater than 98% of the Po 210 Po2 was retained by the first 2 cm of soil with $K_{sub d}$'s greater than 100. Top soil samples with $K_{sub d}$'s less than 100 indicated Po 210 Po2 would be retained by the lower soil horizons. Hazards to water supplies by movement of 210 pPc through soil would be minimal. Chemical species of 210 Po in soil solution passed through a semi-permeable membrane. Plant uptake of Po 210 Po2 added to three different soils was measured and expressed as a transfer coefficient, U , where $U = 210 \text{ Po/g dry plant tissue} / 210 \text{ Po/g dry soil}$. Transfer coefficients of 11 different fruit, grain, leafy, and root crops ranged from $10^{(E-2)}$ to $10^{(E-6)}$. The transfer coefficients remained constant for the majority of plant tissues examined, although the distribution coefficients differed for the three soils used. Calculations using the transfer coefficients for estimating dietary intake of 210 Po from vegetables indicated a potential long-term ingestion hazard to the population. Protein hydrolyzates of wheat and spinach were separated by paper chromatography to investigate organic forms of polonium in plants. One possible organic form of polonium was observed. Measurements of naturally

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occurring ^{210}Po in the soil samples indicated a range of 0.22 to 3.47 pCi/g in top soils. Polonium 210 measured in the vegetation used for controls in the greenhouse experiments indicated the primary source of the isotope was the fallout of airborne ^{210}Po and its radioactive precursors. (NSA)

<492>

Hansen, W.R., and R.L. Watters, Plant Uptake of Polonium 210 from Soil. 1970. Radiation Botany, 10, 371-375 (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO)

A study of plants grown in Polonium 210-labeled PoO_2 contaminated soil indicated definite uptake through the root system. The Po concentration in the tissues varied with plant species and decreased with period of growth. Transfer coefficients (Po 210 per g dry plant/ Po 210 per g dry soil) were calculated and ranged from 3×10^{-2} to 3×10^{-6} for the plants grown in Polonium 210-labeled PoO_2 contaminated soil. Comparison of the natural concentrations of Po 210 in plants with the data for those grown in contaminated soil confirmed that natural fallout of radon daughters is the primary source of natural Po 210 in plants. (Auth)

<493>

Hansen, W.R., and R.L. Watters, Unsupported Polonium 210 Oxide in Soil: Soil Adsorption and Characterization of Soil Solution Species. 1971. Soil Science, 112, 145-155 (Colorado State University, Fort Collins, CO)

The adsorption of polonium 210 oxide by agricultural top soils was correlated with the silt content. The adsorption of polonium oxide on all soil horizons was correlated with both the pH and silt content of the soils. Equations were formulated from the data for prediction of the distribution coefficient of polonium in soils. The equations are: 1) Agricultural top soils: $\ln K_{\text{sub d}} = 3.2 + 0.046 (\text{per cent silt})$ and 2) Combined A, B, and C soil horizons $\ln K_{\text{sub d}} = -1.3 + 0.034 (\text{per cent silt}) + 0.88 \text{ pH}$. Soil adsorption of Po 210 PoO_2 expressed as a distribution coefficient, $K_{\text{sub d}}$, was confirmed by soil column elution experiments. Soils in columns with $K_{\text{sub d}}$'s greater than 100 adsorbed greater than 98% of the Po 210 PoO_2 in the first two cm with normal annual rainfall equivalent eluants. Soil in columns with a $K_{\text{sub d}}$ less than 100 did not adsorb the total Po 210 PoO_2 added, but allowed movement with water. Electrophoresis experiments indicated both positive and negative species of Po 210 in soil solution. Dialysis experiments with Visking dialysis membranes indicated an average of 34% dialyzable polonium species in soil solution after equilibration with the soil solid phases. (Auth)

<494>

Hansen, W.R., R.L. Watters, and N.D. Yaney, Polonium 210 Dioxide Movement in a Mountain Watershed Soil. 1971. Health Physics, 20, 425-429 (Colorado State University, Fort Collins, CO; Purdue University, Hammond, IN)

Uniform contamination of a Rocky Mountain watershed with Po 210 PoO_2 from a SNAP generator would find the major contamination retained by the soil. A simulated snow-melt run-off experiment was conducted with a mountain Podzol soil from the Fraser Alpine Area, Colorado. Po 210 PoO_2 was applied to

the litter layer as a point source one meter from water collection vessels at the base of a 30% slope. Cores from the soil on which one mean annual rainfall (18.6 in.) of ice was melted indicated both vertical and horizontal movement of Po 210 PoO_2 into the soil. The run-off water collected at the base of the slope at the bottom of the litter layer and a sub 2 horizon indicated only 10 (E-7) of the original activity moved through these soil horizons. Data from soil cores were used to predict the movement of a uniform deposition of Po 210 PoO_2 to a stream. The equations derived indicate only the first 50 cm bordering a stream contribute significant contamination to the water. (Auth)

<495>

Hanson, W.C., and I.L. Eberhardt, Effective Half-Times of Radionuclides in Alaskan Lichens and Eskimos. 1969. CONF-670503; Part of Nelson, D.J. and Evans, F.C. (Eds.), Proceedings of the Second National Symposium on Radioecology, held in Ann Arbor, Michigan, May 15-17, 1967, (p. 627-634), 774 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Half-times of radionuclides in lichens were determined after sprinkling radionuclides on natural communities of lichens. Strontium was lost more readily from the lichens than the cesium radionuclides. The authors concluded that the effective half-life of cesium in lichens is greater than 10 years. (CWF)

<496>

Hanson, W.C., and I.L. Eberhardt, Cycling and Compartmentalizing of Radionuclides in Northern Alaskan Lichen Communities. 1971. BNWL-SA-3863; CONF-710501-1; Part of Nelson, D.J. (Ed.), Proceedings of the Third National Symposium on Radioecology held in Oak Ridge, Tennessee, May 10-12, 1971, (p. 71-75), 1268 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Cycling of Cs 137 and other fallout radionuclides in natural lichen communities of Northern Alaska was studied by periodic sampling on a year-round basis during the period 1964 through 1969. Maximum concentrations usually occurred during summer months and minima during winter months. Vertical strata of lichens, humus and soil taken at those times showed pronounced seasonal shifting of radionuclides between community components. These data partially account for the sudden increase in Cs 137 body burdens of northern Alaskan caribou during spring months of each year and have important implications in the Eskimo populations dependent upon the caribou for basic food. (Auth)

<497>

Hardcastle, J.E., The Radioassay of Calcium 45 and Strontium 89 from Biological Systems by Liquid Scintillation Counting. 1967. Ph.D. Thesis; 93 p. (University of Arizona, Tucson, AZ)

The development of methods for the radioassay of Ca 45, Sr 89, and Ca 45-Sr 89 double-labeled samples by liquid scintillation spectrometry is reported. The samples, obtained from such natural sources as plants and soils, were first digested and converted to the chloride form. Then the chloride salt of the isotopes was dissolved in a di-n-propyl phosphate-toluene-fluor scintillation mixture, and counted in a liquid scintillation spectrometer. A method is described for calculating the individual isotope activities

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from a Ca 45-Sr 89 double-labeled sample. The factors affecting this radioassay technique were studied. Counting efficiencies of 85% for Ca 45 and 95% for Sr 89 were obtained using this procedure. The procedure is simple, fairly rapid, and capable of high precision. (Auth)

<498>

Harder, R., and S. Chaberek, The Interaction of Rare Earth Ions with Diethylenetriaminepentaacetic Acid. 1959. J. Inorg. Nucl. Chem., 11, 197-209 (Dow Chemical Company, Eastern Research Laboratory, Framingham, MA)

The interactions of rare earth ions with diethylenetriaminepentaacetic acid have been investigated by potentiometric procedures. Metal chelate formation constants have been calculated and compared with those defining similar interactions with ethylenediaminetetraacetic acid and N-hydroxyethylthylenediaminetriacetic acid. (Auth)

<499>

Hardy, E.P., Strontium 90 in Northern Hemisphere Soils Collected in 1964, 1965, and Early 1966. 1966. HASL-173; Part of Hardy, E.P., Jr., and Rivera, J., Fallout Program Quarterly Summary Report, October 1, 1966, (p. I.2-I.9) (U.S. Department of Agriculture, Soil Conservation Service, Beltsville, MD)

The distribution of strontium 90 in various soil profiles throughout the United States is presented. (CWF)

<500>

Hardy, E.P., F.W. Krey, and H.L. Volchok, Plutonium Fallout in Utah. 1972, July. HASL-257; (p. I.95-I.118)

Accumulated plutonium fallout in the north central and southeastern sections of Utah was measured in soil samples collected in June 1971. The maximum values in Utah of the deposition (mCi Pu 239 and Pu 240 per km²) and deposition concentration (mCi per kg of soil of precipitation) were 2.2 and 3.8 times the maximum values found anywhere else in the United States. By comparing the Pu 239, 240 to Sr 90 activity ratios of the Utah soils with the average activity ratio of 32 Northern Hemisphere soils collected in 1970-71, it was estimated that up to 60 percent of the total Pu 239, 240 activity deposited at some Utah sites was from a source other than the stratospheric reservoir. Soil samples taken at a site near the University of Utah from 1959 through 1971 revealed that the excess plutonium was delivered prior to 1959. Mass isotopic analyses indicate that the Nevada Test Site is the probable second source and that about 3.5 mCi Pu 239, 240 per km² or twice the level expected from global fallout, deposited in the Salt Lake City area from MTS. Excess plutonium was not evident at sites north of Salt Lake City and due east in the valley regions beyond the Wasatch range. (Auth)

<501>

Haunold, E., and F. Wurst, Uptake of Copper 64 by Excised Plant Roots from Nutrient Solutions. 1970, October. CONF-710202-1; SGAE-LA-3/1970; Part of Proceedings of an International Symposium on Soil Fertility held in New Delhi, India, February 9-14, 1971, (10 p.) (Oesterreichische Studiengesellschaft fuer Atomenergie, G.m.b.H., Landwirtschaftliche Forschungsabt, Seibersdorf,

Austria)

Cu 64 uptake by excised roots of barley, beans, and peas was studied using Cu(NO₃)₂ and Hoagland-solutions having a Cu concentration of 3.2×10^{-7} M. Barley roots took up Cu in increasing amounts with an increase in pH from 5 to 7 and a change from Cu(NO₃)₂ to Hoagland-solution. Beans and peas that absorbed Cu at a much greater rate than barley were hardly influenced by pH or solution composition. Since Cu uptake was depressed by 2,4-DNP and chloramphenicol, uptake was considered to depend on metabolism being linked to ATP synthesis. (Auth)

<502>

Havlik, B., Radioactive Pollution of Rivers in Czechoslovakia. 1970, November. Health Physics, 19, 617-624 (Institute of Hygiene, Prague, Czechoslovakia)

One of the oldest uranium mining areas in the world is the spa Jachymov in Bohemia. A study of environmental contamination began there when uranium mining was at a maximum, and continued until mining ceased 6 years later. Content of Ra 226 and total beta activity of water, river sediments and water plants were estimated in the streams of this area and from the other uranium ore area, where mining reached its maximum during the study period. Radioactive pollution of the major Czechoslovak rivers during 1964 to 1967 is described. (Auth)

<503>

Hawkins, R.H., R.F. Overman, and J.C. Corey, Thallium 208 and Sodium 24 Gamma Sources for Identifying Soil Water Tagged with Deuterium. 1971. Soil Science Society America Proceedings, 35, 199-201 (Savannah River Laboratory, Aiken, SC)

In situ tracing of soil water movement with the D20-Na 24 method has been limited by the need to reactivate the Na 24 gamma source frequently (half-life of 15 hours) in a nuclear reactor. Our laboratory study showed Tl 208 produced the same neutron count rates from vials of D20 in dry and moist soil as did Na 24. The 1.9-year effective half-life of Tl 208 in equilibrium with its parent nuclide Th 228 is a significant advantage of Tl 208 over Na 24. Recent commercial availability of Tl 208 sources now makes in situ D20 tracing of soil water feasible for investigators not having access to a nuclear reactor. (Auth)

<504>

Hawthorne, H.A., Effect of Ammonium Nitrate on the Strontium 90 Concentration in Tomato Organs. 1968. UCLA-12-772; 23 p. (University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

Four calcareous and one acid soil were contaminated with Sr 90, fertilized with ammonium nitrate, and used as substrate for tomato plants in a growth chamber. The free CaCO₃ content of the soils ranged from 0 to 33%; ammonium nitrate levels were 0, 100, 200, and 400 parts per million as nitrogen. Significantly lower ($P < .001$) Sr 90 concentrations occurred in leaves of plants grown in unfertilized acid soil compared to those from acid soil fertilized with 100 parts per million nitrogen; these two nitrogen levels and soil resulted in plants with leaves having the minimum and the maximum observed concentrations of Sr 90. Plants grown in calcareous soils, fertilized or unfertilized, had leaves with intermediate Sr 90

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concentrations. The concentration of Sr 90 in stems was increased ($P < .001$) by increasing rates of nitrogen fertilization, as was the concentration in roots ($P < .005$). The concentrations in the plants were leaves > stems > roots in the approximate ratio of 5 : 3 : 2, respectively. The amounts of Sr 90 recovered from soils were variable because plant growth rates and tissue concentrations of Sr 90 were confounded, as shown by the high interaction term (nitrogen x soil) in the analysis of variance ($P < .005$). The minimum concentrations of Sr 90 occurred in plants from unfertilized acid soil, instead of in plants from high-calcium soils. This observation suggests that Sr 90 studies, in which acid soils were fertilized with nitrogenous materials before experimental treatments were instituted, may benefit from reassessment. The conclusions drawn from such studies may apply to an artifact of soil management, rather than to acid soils per se. (Auth)

<505>

Heald, W.R., Characterization of Exchange Reactions of Strontium or Calcium on Four Clays. 1960. Soil Science Society of America Proceedings, 24, 103-106 (Department of Agriculture, Soil and Water Conservation Research Division, Beltsville, MD)

To a series of calcium or strontium saturated clays suspended in 50 symmetry concentrations of the saturating ion, variable amounts of $\text{Sr}^{85}\text{Cl}_2$ or $\text{Ca}^{45}\text{Cl}_2$ were added. From the radiochemical analysis of the clay at equilibrium, the amount of exchange was determined. Plotting the data yielded a curved line composed of at least two adsorption isotherms. This is interpreted to mean two independent sites of adsorption or that two mass action equations are necessary to describe the system. Following the cation desorbed by tracer technique resulted in almost identical curves as when the adsorbing cation was followed. This evidence showed that no precipitation or reaction other than the one described took place. (Auth)

<506>

Healy, W.B., W.J. McCabe, and G.F. Wilson, Ingested Soil as a Source of Microelements for Grazing Animals. 1970. New Zealand Journal of Agricultural Res., 13(3), 503-521 (New Zealand Department of Scientific and Industrial Research, Soil Bureau, P.B., Lower Hutt, New Zealand; New Zealand Department of Scientific and Industrial Research, Institute of Nuclear Sciences, P.B., Lower Hutt, New Zealand; Massey University, Dairy Husbandry Department, Palmerston North, New Zealand)

Two sheep were drenched each with 100 g of soil containing approximately 1 μCi each of Co^{60} , Mn^{54} , Se^{75} , and Zn^{65} . Activities of these isotopes in blood, urine, and feces were monitored at intervals over a 10 day period by gamma-ray spectroscopy. At the end of this period the animals were killed and a range of hard and soft tissue samples was taken for analysis. From the data obtained on blood and tissue samples taken at time of death, and from urine samples over the 10 day period, amounts of isotopes absorbed by the animals and amounts of isotopes originally held on the ingested soil were compared. The amounts of the isotopes absorbed by the animals from the soil, expressed as a percentage of an isotope held on the soil, were approximately: Se^{75} , 34 percent; Zn^{65} , 14 percent; Co^{60} , 1 percent; Mn^{54} , 0.4 percent. (Auth)

<507>

Hebrard, J.P., L. Foulquier, and A. Grauby, Use of Ground Moss (*GRIMMIA ORBICULARIS* Bruch) for Indicating the Presence of Manganese 54, Cesium 137, and Strontium 90. 1972. Radioprotection, 7, 159-177 (CNRS, Marseille, France)

Ground moss (*GRIMMIA ORBICULARIS* Bruch) was experimentally contaminated with Mn^{54} , Cs^{137} , and Sr^{90} . The plant fixing capacity from the water and soil was studied for each radionuclide. The role of the hygrometric variations on the kinetics and intensity of the contamination was studied. The respective values for the concentration factors of Mn^{54} , Cs^{137} , and Sr^{90} are of the order of 700, between 90 and 180, and between 100 and 500. The alternating drying and rehydrating phases of the medium have little effect on the fixation rate for these radionuclides. (NSA)

<508>

Held, E.E., S.P. Gessel, and R.B. Walker, Atoll Soil Types in Relation to the Distribution of Fallout Radionuclides. 1965, August. UWPL-92; 37 p. (University of Washington, Laboratory of Radiation Biology, Seattle, WA)

The redistribution of radionuclides in atoll soils following fallout from a nuclear device is described. The soils are calcareous, containing no inorganic colloids, and their exchange capacity is directly related to organic content. Comparison of gamma-ray spectra of depth increments from young and old soils shows that Cs^{137} and Sb^{125} move most readily in old soil, while the principal gamma-emitting radionuclides moving in young soil is Sb^{125} . Sr moves in both old and new soils, and quantitative differences in vertical movement between soil types is obscured by the highly variable surface distribution of the radionuclides. Vertical gradients in the distribution occurs within the surface inch. Litter redeposits Cs^{137} and Sr^{90} at the soil surface and bird droppings have added Zn^{65} and Co^{60} . In young soils the highest levels of radioactivity are associated with soil algae found as a surface crust in undisturbed areas and in coral fragments in eroded areas. Horizontal movement is localized. Buried organic horizons contain more Cs^{137} than adjacent soil layers, and roots are generally more radioactive than the surrounding soil except at the soil surface. Pumice particles in the soil adsorb radionuclides but pumice is found infrequently. Mechanical mixing by animals in old soils and by erosion in young soils is important in the redistribution of radionuclides near the soil surface. Cs^{137} and Sr^{90} are the principal radionuclides entering a cycle within the soil-plant system. (Auth)

<509>

Hemwall, J.B., Reaction of Ferric Ethylenediaminetetraacetate with Soil Clay Minerals. 1958. Soil Science, 86, 126-132 (Dow Chemical Company, Western Division, Agricultural Research Laboratory, Seal Beach, CA)

Investigations showed that FeEDTA or EDTA were not adsorbed by clay minerals. Iron, however, was removed from the FeEDTA and adsorbed to the clay minerals. (CWF)

<510>

Henny, H., and R. Overstreet, Surface Migration of Ions and Contact Exchange. 1939. Journal of

<510> CONT.

Physical Chemistry, 43, 1185-1196

A theory of ionic movement in colloidal systems is proposed involving ions held in the adsorbed state on the surfaces of the micells. The theory is used to interpret observations on the migration of ferrous iron in gels and soils of the bentonitic clays. The ions diffuse on the surface of the colloidal particles and "jump" from one particle to another. The theory suggests a new mode of mineral nutrition of plants in soils, based on interpenetrating double layers of root colloids and soil colloids. It is shown that roots in contact with clay particles gain as well as lose nutrient cations. (Auth)

<511>

Henzel, N., Model Studies on the Penetration of Fallout in Various Soils. 1967. Z. Geophys., 33, 33-47 (Battelle Memorial Institute, Frankfurt am Main, German Federal Republic)

The penetration of slightly soluble and soluble artificially constituted fallouts into various soils was investigated taking into consideration particle size, solubility, and radiation characteristics of radionuclides of fallout from nuclear explosions. The experiments with slightly soluble model fallout (quartz powder ranging from coarse silt to fine sand particle size labeled with Zr 96/Nb 95 or Sr 90/Y 90) were carried out in a lysimeter filled with sandy or humus type loamy soil. Usually humus loamy soil and silty clay soil showed the strongest retention for the fission products investigated, whereas sandy soils showed the least retention. (NSA) (CWF)

<512>

Herbst, V.W., Studien zur Radioaktiven Kontamination der Menschlichen Umwelt. 1. Boden und Pflanzenwelt. 1959. Atompraxis, 5, 280-284 (University of Freiburg, Institute of Radiology, Freiburg, German Federal Republic)

Various stations in the biological passage of radionuclides in soil and plants were studied by observations of a fallout model and by experimental radioactive labeling of processes. The particular risk of incorporating radioactive substances via biocycles with food as a vehicle is discussed. Experiments with P 32 and Sr 90 as labels show the dependence of soil sorption upon the type and condition of the soil, and upon ion antagonisms in the soil, as well as sorption stability towards precipitation effect. The periodic table of the elements is used to show the particular tendencies of the higher plants towards an excessive uptake of fission products. In sandy soil the humus component lessens the Sr 90 uptake of plants through the roots. P 32 in plants is released from the roots into the milieu through ion exchange at the rate of 1 percent per day. Radioactive contamination of the sprout organs can result in a cuticular uptake of nuclides or a surface sorption of radioactive substances. The length of the vegetation period is an important factor in determining the extent of contamination in the fallout field. Vegetation has a filter effect in regard to radioactive material in the atmosphere. (tr-Auth)

<513>

Hill, C.R., Routes of Uptake of Polonium 210 into Human Tissues. 1966. CONF-660405; Part of Aberg, B. and Hunkate, F.P. (Eds.),

Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, (p. 297-302), 1051p. (Institute of Cancer Research, Belmont, Surrey, England)

Data indicates that the most important source of natural polonium 210 body burden is the diet. (CWF)

<514>

Himes, F.L., and S.A. Barber, Chelating Ability of Soil Organic Matter. 1957. Soil Science Society of America Proceedings, 21, 368-373 (Purdue University, Agriculture Experiment Station, Lafayette, IN)

It was discovered that organic matter reacted with divalent metal ions in a manner similar to chelation reactions. Radioactive zinc was used to facilitate the adsorption measurements. Multiple regression was used to develop a prediction equation to determine the amount of zinc adsorbed as influenced by zinc added, pH, and ionic strength of the solution. Removal of organic matter by oxidation with hydrogen peroxide destroyed the ability of the soil to chelate zinc. Removal of hydrous silicates did not influence the retention of zinc by the soil. The organic matter was fractionated into the humic and fulvic fractions. Both fractions reacted with zinc in a manner similar to the untreated soil. Methylation of the organic matter was used to determine the functional groups involved in the chelation reaction. Carboxyl groups did not appear to be important. The stability constant for the zinc soil complex was investigated by two independent methods. For a Maumee sandy loam soil at pH 7 and 2N KCl it was found to be 5.6. (Auth)

<515>

Himes, F.L., and A. Manqaroo, Influence of Organic Compounds on the Movement of Strontium in Soils and on the Uptake by Plants. 1965. CONF-65114-2; Part of Proceedings of the American Society of Agronomy Annual Meeting held in Columbus, Ohio, October 31-November 5, 1965 (Ohio Agricultural Research and Development Center, Wooster, OH)

The stability constants for Sr-organic matter products ranged from 1.42 to 14.46. The soils formed under neutral conditions had higher constants than those formed under very acid conditions. The stability constants increased when the clay minerals and other HF-soluble materials were removed. The uptake of Sr decreased rapidly as the stability constants for the Sr-organic matter increased from 5 to 9. The phytic acid solution was very effective in leaching Sr from the soil columns. Nitrilotriacetic acid and EDTA were usually intermediate in efficiency of leaching and the other compounds were less effective. The water extract of the AB-38 soil was very efficient in leaching Sr from another sample of AB-38 soil. (Auth)

<516>

Himes, F.L., and R. Shufeldt, Influence of Some Organic Compounds on the Movement of Strontium 90 in Soils. 1969. COO-414-11; CONF-690918-(Vol. 1); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 493-507), 506 p. (Ohio Agricultural Research and Development Center, Department of Agronomy, Wooster, OH)

The leachates of undisturbed Canfield soil in

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lysimeters contain some Sr 90. The influences of organic compounds and of soil organic matter on the movement of Sr 90 have been studied. The decreasing order of effectiveness of organic compounds on the quantity of Sr 90 adsorbed by most soil samples is: phytic acid, glucuronic acid, citric acid, pectic acid, pyrocatechol, glycine, and dextrose. The adsorption of Sr 90 by soil samples after treatment with dilute HF could be altered by methylation. Methylation of soil organic matter with diazomethane decreased the quantities of exchangeable and chelated Sr fractions proportionally more than the non-displaceable fraction. Methylation with CH₃OH-BF₃ decreased only the non-displaceable fraction. In general, the quantity of water soluble Sr was greater for soil samples that had been oven-dried than for samples kept continuously moist. (Auth)

<517>

Hingston, F.J., A.M. Posner, and J.P. Quirk, Anion Binding at Oxide Surfaces - The Adsorption Envelope. 1970. Search, 1(6), 324-327 (University of Western Australia, Institute of Agriculture, Department of Soil Science and Plant Nutrition, Australia)

The mechanism for specific adsorption of anions at mineral-aqueous solution interfaces is relevant to studies of water purification, plant nutrition, and bone chemistry. The correlation between the pK values of the conjugate acids of the various anions and the pH values at which specific adsorption shows a marked change suggests that specific adsorption depends on the ease of dissociation of the conjugate acids at the mineral surface. It is considered that these ideas also apply to the specific adsorption of cations at mineral surfaces. (Auth)

<518>

Hiyami, Y., Biochemical Studies of Strontium 90, Cesium 137 and Similar Radionuclides. 1962. AEC-tr-4642; 36 p. (University of Tokyo, Tokyo, Japan)

As part of a study to make quantitative measurements of the movement through food chains and equilibrium relations of fallout material (primarily Sr 90 and Cs 137), progress on the following investigations is reported: Sr 90 content in lake water, aquatic plants, and representative rivers of Japan, 1957-1960; Cs 137 accumulation in soil, leaching by rivers, movement to food, and accumulation on a peat plateau; uptake of Sr 89, Ca 45, and Ba 140 and discrimination factors; radionuclide concentrations in tea leaves; Cs 137 determination in milk products; upward trend of the Sr 90 content of the biosphere; Sr 90 content of an average diet; Sr 90 in human bones; and the effect of Ca in the diet upon the retention of radioactive Sr. (ST)

<519>

Hodgson, J.F., Cobalt Reactions with Montmorillonite. 1960. Soil Science Society of America Proceedings, 24, 165-168 (U.S. Department of Agriculture, Ithaca, NY)

Specific reactions between montmorillonite and Co in low concentrations were studied in the presence of excess CaCl₂. Two forms of bound Co were distinguished. One form, characterized as being slowly dissociable, appears to be bound in a monolayer by

chemisorption and will exchange with Cu(+2), Zn(+2), or other Co(+2) and to a lesser extent with ions of other transition metals but not with Ca(+2), Mg(+2), or NH₄(+1). A second form of Co did not dissociate and could not be extracted from the mineral with 2.5 percent acetic acid. This fraction, which was not characterized, is thought to either enter the crystal lattice or be occluded in the precipitation of another phase. (Auth)

<520>

Hodgson, J.F., H.R. Geering, and M. Fellows, The Influence of Fluoride, Temperature, Calcium, and Alcohol on the Reaction of Cobalt with Montmorillonite. 1964. Soil Science Society of America Proceedings, 28, 38-42 (U.S. Department of Agriculture, Ithaca, NY)

Pretreatment of montmorillonite with F interferes with the adsorption of Co by montmorillonite. Since the effect is reversible with base, the F is thought to replace surface hydroxyl groups that serve as the adsorption sites for Co. The Co reaction with these sites increases with temperature, indicating that the reaction is endothermic. Therefore, either heat is required to form the Co-to-surface bond or the cation is replacing more strongly bound surface hydrogens such as those associated with the hydroxyls mentioned above. While certain other heavy metal cations were previously shown to exchange with adsorbed Co, Ca is found to have no effect on the reaction, except to alter the activity coefficient of Co in solution. This is interpreted as indicating the absence of any charge associated with the bonding site. Alcohol is found to enhance the reaction of Co with montmorillonite in contrast to what would be expected if hydrolysis played a role in the reaction. (Auth)

<521>

Hodgson, J.F., K.G. Tiller, and M. Fellows, Effect of Iron Removal on Cobalt Sorption by Clays. 1969. Soil Science, 108, 391-396 (U.S. Department of Agriculture, Ithaca, NY)

Clay fractions from seven soils were extracted with a modification of Jefferies iron removal procedure before allowing them to adsorb Co from solutions containing abundant Ca. In a previous examination, the seven clay fractions had adsorbed very similar amounts of Co even though their mineral composition varied appreciably. Pretreatments with peroxide and base had had little effect on the reactivity of the materials with Co. The iron removal procedure had more effect than any previous pretreatment, increasing the adsorption of Co in four of the seven soils. Nonetheless the most prominent feature of the results is the similarity among the adsorption characteristics of the different soil clays. This observation is consistent with the contention developed earlier that it is not the crystalline structure of given clay minerals but alterations in that structure that give rise to the specific adsorption of Co by soil clays. (Auth)

<522>

Hoffman, G.R., Accumulation of Cesium 137 by Cryptogams in a LIRIODENDRON TULIPIFERA Forest. 1972. Botanical Gazette, 133, 107-119 (University of South Dakota, Vermillion, SD)

The accumulation of Cs 137 in cryptogamic components of a tagged LIRIODENDRON TULIPIFERA L. forest at Oak Ridge, Tennessee, was determined in 1968. Within a 500 m² study

<522> CONT.

plot, tagged in 1962 with 467 mCi Cs 137, terrestrial bryophytes had accumulated 1.16 mCi, tree-base mosses 0.39 mCi, epiphytic lichens on main stems 2.52 mCi, and canopy lichens 0.16 mCi. The total, 4.23 mCi, is less than 1% of the total Cs 137 introduced in 1962, but the Cs 137 content of certain of the cryptoqams was greater, on a unit dry weight basis, than tree foliage which represents the source of the radionuclide to the cryptoqams. Terrestrial bryophytes receive all, or most, of their Cs 137 directly from rain drip from the overhead tree canopies, and epiphytes receive their Cs 137 from stemflow. Experimentally determined uptake efficiencies of Cs 137 were 92% for the terrestrial bryophyte mat (living plus dead), and 67% for the vertically oriented epiphytic lichens, most of which were foliose. Tree-base mosses plus their absorbent bark substrate absorbed 90% of the Cs 137 supply. Loss rates of Cs 137 by cryptoqams were also determined experimentally. The interpretation of "uptake" (or "input") influences the calculation of loss rates. If uptake is considered to be the total supply of Cs 137 which reaches the cryptoqams, loss rates will necessarily be higher than if uptake is that amount of Cs 137 which reaches the cryptoqams multiplied by an uptake fraction; the uptake fraction is determined experimentally. Elimination half-times are discussed in light of loss rate calculations. A computer simulation of Cs 137 accumulation by cryptoqams from 1962 to 1969 was done to provide visual form to the process of accumulation by the cryptoqamic components of the LIRIODENDRON forest. (Auth)

<523>

Holobrada, M., Some Aspects of the Uptake and Conversion of S-Sulfate 35 to the Organic Form in Plants. 1970. Biologia (Bratislava), 25, 667-671 (Botanical Institute, Bratislava, Czechoslovakia)

While growing peas in full nutrient solution with addition of S35 labelled Na2S04, the dynamics of the S-sulfate 35 in different organs of the pea and the incorporation of S 35 in free organic compounds were followed. The inorganic form of S 35 in the pea seeds is already present on the first day of the experiment. After the piercing of the seed coat by the radicle the presence of free organic S-compounds was also demonstrated. At first, in the roots, an accumulation of S-sulfate 35, which was incorporated in free organic compounds after the third day of the growth of the roots, was noted. In the above-ground organs S-sulfate 35, in this way as in the roots, was incorporated in organic compounds after a previous accumulation. (Auth)

<524>

Holowaychuk, N., and P.L. Gersper, Sampling and Analyses of Tree Leaves and Soils from Strontium Treated Plots. 1965. TID-22443; (p. 100-111) (Ohio Agricultural Research and Development Center, Wooster, OH)

Analyses of tree leaf samples from plots treated with stable Strontium show that species having a high Ca content take up considerably more Sr than do the low Ca content species on acid soils. This difference between species is much less marked on soils having a high content of bases. The biggest increase in uptake of Sr occurs during the second year after application. There is further but less marked increase after the second year in case of the high Ca content

species whereas there is little if any such additional increase in the other species. (NSA)

<525>

Holowaychuk, N., P.L. Gersper, and L.P. Wilding, Strontium 90 Content of Soils Near Cape Thompson, Alaska. 1969. Soil Science, 107, 137-144 (Ohio State University, Columbus, OH; Ohio Agricultural Research and Development Center, Wooster, OH)

Deposition and distribution of strontium 90 in soils of an Alaskan watershed were determined. Very poorly drained soils had a higher concentration of strontium 90 than better drained soils. The authors indicated the redistribution was caused by lateral movement of the soil leachate. (CWF)

<526>

Holtzman, R.B., Measurement of the Natural Contents of RaD (Lead 210) and RaF (Polonium 210) in Human Bone--Estimates of Whole-Body Burdens. 1963. Health Physics, 9, 385-400 (Argonne National Laboratory, Radiological Physics Division, Argonne, IL)

The natural RaD (Pb 210) concentration in man has been determined from measurement of the RaF (Po 210) in bone samples obtained from surgery and autopsy of unexposed individuals, mostly from Illinois. About 63 percent of the RaD is in the skeleton in apparent equilibrium with RaF and, within a factor of 2, it is uniformly distributed in the skeleton. The average RaD concentration found in 128 bone samples was 0.145 plus or minus 0.020 pc/q ash as compared to an average Ra 226 concentration of 0.037 plus or minus 0.007 pc/q ash. Little correlation between the two nuclides was observed. The average RaD concentrations in the skeleton were 0.161 pc/q ash in men and 0.119 pc/q ash in women. These concentrations were generally higher in trabecular than in cortical bone, 0.184 and 0.105 pc/q ash, respectively. No particular correlation was found between the residence histories of the donors and the RaD concentrations in their skeletons. Calculations based on some of the metabolic parameters of lead and on the known concentrations of Ra 226, Rn 222 and RaD in the human biosphere, show food and air to be the major contributors of RaD in the subjects studied. The RaDEF decay chain is shown to contribute a radiation dose to the human skeleton more than double that from Ra 226 and about equal to that from Ra 226 and Ra 228 combined. (Auth)

<527>

Holtzman, R.B., Isotopic Composition as a Natural Tracer of Lead in the Environment. 1970, April. Environ. Sci. Technol., 4, 314-317

The method of variations in isotopic ratios to trace the sources of environmental lead and to determine the respective fractions originating from natural and from artificial causes is discussed. The measurements of Pb 210 and stable lead were made on four trees 100 to 120 years old, a hickory, a black oak, and two white oaks. A cross section of each trunk taken about 6 feet above the ground was examined. A 30-year old elm was examined for stable Pb. Results and conclusions were made concerning the concentration of Pb 210 in each type of tree. The method could be useful in tracing ultimate sources of Pb in man. If food plants are like wood and discriminate between the 204 and 206 isotopes, and if the 206/204 ratios are significantly higher or lower than in the gross sources (atmosphere

<527> CONT.

and soil), then these could be studied under various conditions. (NSA)

<528>

Holtzman, R.B., and F.H. Ilcewicz, Lead 210 and Polonium 210 in Wood and the Circulation of Lead in Trees. ANL-7615; 38-43 (Argonne National Laboratory, Argonne, IL)

Measurements of Pb 210 and Po 210 concentrations in tree rings from four 100-year-old trees were made to estimate the rates of radial translocation. Decrease of the concentration of the 210 Pb with a 21.4-year half-life showed that there is little circulation of lead in hickory heartwood more than 20 years old. In oak there appears to be little circulation in wood less than 5 years old, but this conclusion is less reliable because of the low concentration of the Pb 210 and the presence of Ra 226. The concentrations of the Po 210 correlated fairly well with those of the Pb 210. Preliminary measurements of the stable lead concentrations did not show increased uptake in recent times. However, more detailed studies on the Pb 210 and stable lead concentrations are needed to determine the value of the heartwood of trees as a temporal record of lead contamination of the environment. (Auth)

<529>

Hougen, O.A., and W.R. Marshall, Jr., Adsorption from a Fluid Stream Flowing Through a Stationary Granular Bed. 1947. Chemical Engineering Progress, 43(4), 197-208 (University of Wisconsin, Chemical Engineering Department Madison, WI; E.I. du Pont de Nemours and Company, Engineering Research Laboratory, Wilmington, DE)

Methods are developed for calculating the time-position-temperature-concentration conditions in both gas and solid during the adsorption of dilute gases flowing through granular beds. An analytical method is developed for isothermal conditions where a linear equilibrium relation exists between the adsorbate content of the gas and of the solid. (Auth)

<530>

Howells, H., Trench Disposal of Solid Radioactive Waste from the Windscale and Calder Works of the UKAEA. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 3-13) (United Kingdom Atomic Energy Authority, Sellafield, England)

Windscale and Calder Works of the UKAEA is situated in Cumberland on the northwest coast of England. Large volumes of low activity and suspect active solid wastes arise both from process and laboratory operations. The total quantity is about 1000 tons/yr with an uncompressed volume of about 6000 m³. It is impracticable to use monitoring as a method of segregation into active and inactive fractions. Consequently, all the material must be treated as radioactive waste and disposed of correspondingly. A study of the relative cost of disposal methods has emphasized the expense of pre-treatment such as incineration or baling and shown that local burial without treatment is by far the cheapest method of disposal. This method is possible only if a suitable burial site is available close to the origin of the wastes. If this is not the case, pretreatment becomes necessary to ease the transport problems.

Such a site exists near Windscale and the wastes are collected in transportable containers designed for dumping operations. These containers are picked up by a special vehicle, taken to the burial site and emptied into a trench. The material is covered with earth as dumping proceeds. Monitoring of water from the site shows negligible activity. (Auth)

<531>

Hubbard, J.E., Cesium 137 in an Alpine Watershed. 1968. Ph.D. Thesis; 107 p. (Colorado State University, Fort Collins, CO)

A study was made of the distribution of the fallout radionuclide Cs 137 on the surface and in the stream channel of an alpine watershed in the Colorado Front Range. Cs 137 activities of the surface (mean = 222 nCi/m²) were considerably higher than at Fort Collins, Colorado. The effects of snow-accumulation, soil-vegetation complexes, and the hydrologic surface were studied in relation to Cs 137 activity. Snow-accumulation areas contained significantly more Cs 137 than snow-free areas. Alpine bog contained significantly more Cs 137 than did Alpine Turf and Alpine Meadow soils. Micro-channels and micro-depressions had significantly higher levels of Cs 137 activity than areas characterized as surface runoff. Concentrations of Cs 137 in stream bottom sediments and stream vegetation decreased exponentially downstream with distance from a permanent snowfield at the headwaters. There is some evidence that Cs 137 in sediments is accumulating in a marshy area where the stream flows across the moraine of a former mountain glacier. Cs 137 activities of the sediments were not highly related to percent silt plus clay. Evidence did not support the hypothesis that most Cs 137 would concentrate in the silt plus clay as it moved downstream. Significant quantities of Cs 137 were not found in stream water or the 1967 or 1968 snowpack. Measurable Cs 137 activities were found in litter and inorganic materials in and about the permanent snowfield, and in moss on rocks in the stream channel. (NSA)

<532>

Huffman, C. Jr., and L.B. Riley, The Fluorimetric Method--Its Use and Precision for Determination of Uranium in the Ash of Plants. 1970. U.S. Geol. Surv., Prof. Pap., 700-B, 181-183

The fluorimetric method for determining uranium in the ppm range in plant ash and a study of its precision are presented. The precision of results in the range from 0.4 to 35 ppm uranium in plant ash is expressed by a simple equation (standard deviation = $0.15 + 0.063 U$, is the observed uranium concentration in ppm). This equation is based on 326 pairs of determinations, made during a period of about a year, on samples consisting of ash from sagebrush, piñon pine, ponderosa pine, and juniper. (Auth)

<533>

Huquet, C. J. Delas, and J. Delmas, Experimental Study of the Radioactive Contamination of Some Cultivated Plants by Irrigation Water. 1966, March. Tech. Eau, 231, 31-42

Results are reported from studies on the quantitative relation existing between the application to the soil of long-lived radioisotopes by irrigation water and the level of contamination of the vegetable food

<533> CONT.

products at the limit of accumulation of the radioisotope in the soil. Data are reported for the years 1961 and 1962, the fifth and sixth years of observation. Concentrations of Cesium 137 and Strontium 90 in soils, potatoes, lettuce, carrots, cabbage, cabbage flowerets, green beans, spinach, leeks, and tomatoes are tabulated. The results show that the degree of contamination of the plants is lowered from the second to the third year. In the last year the Strontium 90 begins to appear significantly only in the leafage. (NSA)

<534>

Hulubei, H., C. Moruzi, M. Onescu, and M. Sorciu, Contamination of Some Forms of Vegetation by Long-Lived Fission Products from Nuclear Experiments. 1963. Acad. Repub. Pop. Rom., Stud. Cercet. Fiz., 14, 25-29 (Institute of Atomic Physics, Bucharest, Rumania; University of Bucharest, Bucharest, Rumania)

The beta activity of 14 samples of grass and 121 samples of moss and lichens, gathered during 1960 in various regions of the country, was measured. By comparing the measurements with a Sr 90-Y 90 standard, the equivalent activity of the samples was expressed in uuc units of Sr 90-Y 90. Activities of 5 to 15 uuc Sr 90-Y 90 were found in the grass and 17 to 250 uuc Sr 90-Y 90 in the moss and lichens. It was established that the moss of rocks and trees was capable of fixing larger proportions of fission products than other plants. The highest activities were found in samples of GRIMMIA APOCARPA. By studying the variation of the beta activity during the course of a year, it was concluded that in addition to the equilibrium of Sr 90 with Y 90, other fission products with much shorter half lives than Sr 90 are present. (tr-auth)

<535>

Hungate, F.P., J.F. Cline, R.L. Uhler, and A.A. Selders, Poliar Sorption of Iodine 131 by Plants. 1963. Health Physics, 9, 1159-1166 (Hanford Laboratories, Biology Laboratory, Richland, WA)

Sorption of Iodine(2) 131 by leaves was tested under both laboratory and field conditions. The amount of Iodine 131 sorbed was proportional to the concentration of the gas surrounding the leaves over wide ranges of concentration. Similar proportionality was also noted for the sorption of I 131 to filter paper. Although a significant portion of the I 131 was shown to be inside the leaf, there was little translocation to other plant parts. The extent of I 131 deposited from a melted fuel element under field conditions could not be correlated with pubescence of exposed leaves though some of the deposited material appeared to be particulate. Only 50 percent of the I 131 was removed from leaves with water although 90 percent was potentially removable, as shown with other agents. Much less I 131 was inside the leaves of plants exposed to the fuel element off-gas than in leaves exposed to Iodine(2) 131 in the laboratory, because in the field test, conditions favored closure of the stomata and much of the activity was particulate. (Auth)

<536>

Husted, R.P., and P.F. Low, Ion Diffusion in Bentonite. 1954. Soil Science, 77, 343-353 (Purdue University, Agriculture Experiment Station, Lafayette, IN)

Diffusion studies in bentonite gels showed

that the rate of potassium diffusion depends on the effusion rate of the counter diffusing ion. Diffusion rates were found to be the same as that for ions in solutions, $NH_4^+ > Na^+ > Li^+$. (CWF)

<537>

Hutchin, M.E., and B.E. Vaughan, Relation Between Calcium and Strontium Transport Rates, as Determined Simultaneously in Isolated Segments of Vetch, Barley, and Pine Roots. 1968, April. AD-673381; 28 p. (Naval Radiological Defense Laboratory, San Francisco, CA)

Root segments of vetch, barley, and pine were exposed to nutrient containing Sr 85 and Ca 45 tracers. Transport in both vetch and barley usually declined before an elapsed time of 24 hours unlike corn, which maintained its steady state beyond 24 hours. Pine was radically different in that it showed no difference between acropetal and basipetal transport rates and had very low rates. Sr transport in all plants studied to date followed that of Ca and the ratio of Sr/Ca transported was equal to the ratio of Sr/Ca in the nutrient. In vetch, stable Ca transport was reduced to one-fifth when Sr concentration was increased from 0.5 mM to 2.5 mM. Yet stable Sr transport did not change, indicating that the effect on transport was not due to competitive inhibition. A similar effect was less pronounced in barley, but could not be detected in pine. The magnitude of the transport rates varied considerably between the various species, corn being greatest followed by barley, vetch, and pine in decreasing order. Transport did not correlate with root weight or surface area; it amounted to from 0.03 to 0.60 nanomoles per hour in these experiments as compared to 7 nanomoles per hour previously established in corn (in all cases, 55 mm segments, sectioned 10 mm from apex). (Auth)

<538>

Hutchin, M.E., and B.E. Vaughan, Relation Between Calcium and Strontium Transport Rates as Determined Simultaneously in Isolated Segments of the Primary Root of ZEA MAYS. 1967. Plant Physiology, 42, 644-650 (U.S. Naval Radiological Defense Laboratory, Biological and Medical Sciences Division, San Francisco, CA)

Root segments of ZEA MAYS 55 mm long, were exposed to nutrient containing Sr 85 and Ca 45 tracers. Translocation rather than uptake was measured, using a newly-designed glass compartmentation system and validated tracer analytic model. Ca transport from solutions containing between 0.25 and 5.0 mM Ca was only slightly affected by concentration, but translocation from 0.25 to 0.05 mM solutions was markedly reduced. Maximum transport of strontium from nutrient containing 0.05 mM Ca was twice that from 2.5 mM Ca, and also twice the maximum calcium transported. Thus, under the condition simulating calcium depletion, i.e., 0.05 mM Ca, greater amounts of strontium were transported. In these cases the solutions also contained stable strontium at concentrations between 0.25 and 5.0 mM. In simultaneous determinations, the ratio of Sr to Ca moved was exactly equal to the ratio of their concentrations in nutrient solution, and there was no evidence of discrimination. Dinitrophenol reduced transport of Sr and Ca to an equivalent extent, amounting to between 2 and 9 percent of non-treated control levels. (Auth)

<539>

Ijuin, M., P. Picat, A. Saas, and A. Grauby, Determination of the Diffusion Coefficient of Radioelements in the Rhone Sediments. 1973. Health Physics, 24, 665-672 (National Institute of Radiological Sciences, Department of Environmental Contamination, Anagawa, Chiba-shi, Japan)

The transfer phenomena of Ce 141, Co 60, Cs 137, Mn 54, Sr 85 and Zn 65 in the Rhone sediments were studied in our laboratory. The transfer of the various radioelements in the environment concerned obeys Fick's second law of diffusion. The diffusion coefficients (D) of Sr 85 and Mn 54 were determined. They are respectively $2.1 \times 10^{-2} \text{ cm}^2/\text{day}$ and $1.1 \times 10^{-2} \text{ cm}^2/\text{day}$. The values of the diffusion coefficients of the other elements were not determined accurately enough due to their fixation very near the sediment bed surface. However, they are expected to follow the same diffusion law according to the experimental protocol used. The stable elements in the Rhone sediments were analysed by various spectro-photometric methods and by neutron activation. (Auth)

<540>

Il'in, D.I., A.I. Petrova, and N.Ia. Chepkasova, Migration of Radioactive Materials from an Open Reservoir. 1958. Soviet Journal of Atomic Energy, 5, 890-894

Data is presented concerning the movement of fission products in the ground water surrounding a reservoir used for disposal of radioactive wastes. Radioruthenium was the first radionuclide detected moving from the waste area and laboratory investigations established that it was in the form of a nitrosomitate complex. In this report the authors concluded that properly selected ground disposal sites were adequate for the disposal of strontium, cesium, and rare earth elements. They recommended that selection of the site should be at locations distant enough that the time migrating radioruthenium reaches a drinking water source the lapse of ten half-lives should have taken place. (CWF)

<541>

Il'ina, G.V., and S.G. Rydkii, Study of the Absorption of Radioactive Fission Products by Field Crops. II. Accumulation of Radioactive Fission Products by Grain-Leguminous Mixtures and Perennial Grasses. 1965. Vestn. Mosk. Univ., Ser. VI, Biol. Pochvoved., 20, 3-9 (Not given)

The uptake of Strontium 90 and Yttrium 90 by pea, blue lupine, vetch, millet, and grasses was studied. Leguminous crops accumulated more radioactive fission products than grain crops. Lupine accumulated the maximum content per unit of dry weight. In comparison with the amount introduced into the soil, the amount of radioactive fission products removed with the harvest of grain-leguminous plants and perennial grasses was small. The introduction of a radioactive solution into the soil led to a reduction in the harvest of the majority of grain-leguminous crops and perennial grasses. The introduction of lime into the soil reduced the entry of radioactive substances (strontium 90) into the lucerne plants. (NSA)

<542>

Il'ina, G.V., and S.G. Rydkii, Uptake of Radioactive Fission Products by Field Crops. Report I. Accumulation of Radioactive Fission Products by Grain and Oil-Bearing Crops. 1966.

Federation Proc., Transl. Suppl., 25, T123-T127

The uptake of radioactive fission products was studied in grain crops, buckwheat plants, mustard, millet, bristle grass, and sunflowers. Results showed that grain and oil-bearing crops differ in their ability to extract radioactive fission products from the soil. Uptake of these substances began early and continued throughout the growing period. It was further noted that various plant tissues accumulated different amounts of Sr 90, the leaves having the highest content and the stems and seeds the lowest. The highest Sr 90 content per unit dry matter was seen in buckwheat, mustard, and sunflowers. Removal of fission products with the harvest of the crops was low. (NSA)

<543>

Il'ina, G.V., S.G. Rydkii, and N.W. Kuznetsova, Study of the After-Effects of Radioactive Fission Products on the Harvest and the Quality of the Grain of Certain Crops. 1964. JPRS-28977

Results are reported from field and greenhouse experiments on the effects of a mixture of fission products, in which Sr 90 and Y 90 predominated, added to the soil at a dose of 1.0 uCi per sq. meter, on the growth and yield of oats, mustard, buckwheat and millet cuttings from 3 generations. (NSA) (CWF)

<544>

Il'ina, G.V., S.G. Rydkii, and F.G. Yanovskaya, Uptake of Strontium 90 by Plants in Relation to Some Other Nutrient Elements. 1966. Agrokhisia, 2, 83-92 (Moscow State University, Moscow, USSR)

A 3-yr. research program was carried out to determine the Sr 90 isotope uptake by wheat plants in connection with the interdependence between Sr and Ca, and also with respect to the effects of various conditions that absorbed minerals impose on the uptake of Sr by plants. It was found that the absorption of Sr 90 by plants depended on the pH of soils, a factor which also showed a considerable influence on the competitive action between Ca and Sr. Acid soils treated with Ca in the form of lime reduced the Sr 90 content of wheat plants. Soils treated with an acid salt, ammonium sulfate, increased the Sr content in the grain of growing wheat. Ammonium chloride added to soil also increased the Sr content in wheat kernels, while the admixture of NaNO₃ somewhat decreased the Sr content of wheat grain. Inevitably, the extent of Sr uptake by wheat plants depended on the Sr amounts in soil, but the rate was more varied in vegetative parts of wheat than in kernels. Wheat plants growing in a mildly acid soil, turflike podsol accumulated less Sr in vegetative parts with increasing doses of Ca. A full substitution of Ca by Sr (in chloride form) in sandy soils had unfavorable effects on the growth and development of wheat plants, also on the weight of wheat kernels. (NSA)

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Inre, J., Testing the Air Permeability of Soils by the Radium Emanation Method. 1968, December. Agrokem. Talaitan, 17, 407-424 (National Institute for Agricultural Quality Testing, Szeged, Hungary)

A radium emanation method was developed for testing the air permeability of soils of various structures and colloidal properties. The principle of the method is determination

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of the numerical value of the gas diffusion constant (D) as a physical quantity characteristic of the capillary structure and other colloidal properties of the soil by radiation. The method is quicker, simpler, and demands less work than the usual procedures. It yields estimated data concerning the porosity conditions of the soil in several directions and can be carried out on the site with the soil in its natural undisturbed state. The values of the diffusion constants of the soils tested represent a long scale ranging from the upper limit of more than 200 (starting with the sand soils of coarse texture) or in the surface layer of dry sand soils of 250 to 270 cm²/hr to strongly salt-affected soils of fine texture of less than 2 cm²/hr. The temperature differences existing in the deeper layers of the soils have practically no significant influence on the diffusion constant. On the other hand, great importance has to be attached to the moisture content of the soil in measuring the rate of gas diffusion. While at low moisture content values the curve of the diffusion constant declines slowly, with increasing moisture content, the number of pores permitting diffusion gradually decreases and at the same time the values of the diffusion constant recede considerably. (NSA)

<546>

Inoue, Y., Prediction of Radionuclide Migration in Groundwater at the Japan Atomic Energy Research Institute. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967. (p. 199-213) (Kyoto University, Kyoto, Japan)

The velocity of a radionuclide in groundwater is related to the velocity of groundwater, and the dispersion of radionuclides may be predicated from the dispersion of groundwater. The application of the theory for the prediction of radionuclide movement at the Japan Atomic Energy Research Institute (JAERI) at Tokai-mura is described. JAERI is situated at Tokai-mura, where the formation consists of stratified and loam layers, sloping about 10 degrees toward the Pacific Ocean. This sand layer holds the groundwater. To determine the direction and velocity of ground-water flow, two methods were applied. One was to estimate ground-water flow by Darcy's law with the aid of permeability and equi-water level through measurements of ground-water levels at 53 observation wells throughout the area. The other method was a direct measurement of ground-water flow by the point dilution method, the results of which were used for the correction of data above. The distribution coefficient K_d may be obtained measuring the mass-action constant of the sand or by direct comparison of water and radionuclide travel by passing a radionuclide in groundwater through a soil column. The value of K_d for strontium 90, for example, was 3.6. As the ground-water flow at Tokai-mura has a maximum speed of 16.7 m/day at the JRR-2 reactor site, Sr 90 travel is estimated to be 1.13 m/day at the location. The study is only applicable to the continuous pollution of groundwater by radioactive material, and in the case of an abrupt dose of radionuclides in groundwater, the concentration is expected to be much less due to dispersion. To investigate this, water tracer was injected at one monitoring well and samples collected periodically at observation wells. Because of the slow movement of groundwater (average 30 cm/day), this

observation will need two to three more years before it is completed. (Auth)

<547>

Inoue, Y., and W.J. Kaufman, Prediction of Movement of Radionuclides in Solution through Porous Media. 1963. Health Physics, 9, 705-715 (University of California, School of Public Health, Berkeley, CA)

The disposal of radioactive wastes by injection into deep earth formations requires that predictions be made of the rate of travel of the various radioactive contaminants. The transport of a cationic radionuclide through the earth is determined by hydrodynamic convection, hydraulic dispersion and ion-exchange sorption. If the manner of water movement is first ascertained by tritiated water tracer measurements and the exchange properties are determined by laboratory tests, it is possible to predict the arrival of individual radioisotopes at some distant point of concern. For the prediction theory to be fully applicable, the formation should be reasonably homogeneous, the isotope distribution factor should remain constant, and exchange equilibria should prevail at all points. It is also desirable that the hydraulic flow net remain unchanged. The validity of the prediction theory has been tested with laboratory columns and with a field investigation. The field test involved several arrays of injections and relief wells and twenty-three observation wells penetrating a confined aquifer 100 ft below the earth's surface. The results demonstrated the theoretical validity and practical utility of the theory. (Auth)

<548>

Inoue, Y., and M. Sakanoue, Determination of Plutonium in Soil Samples. 1970, June. J. Radiat. Res., 11, 98-106 (Kanazawa University, Kanazawa, Japan)

The content of Pu 239 in soil was determined by using Pu 238 as yield tracer. The samples were decomposed by nitric acid treatment under ultrasonic vibration and the separation of plutonium from other elements was carried out by using anion exchange resin. Surface soils showed plutonium contents of about 1 to 4 mCi/km² and their Pu 239/Sr 90 activity ratios were 2 to 5 percent. From these results, it was concluded that Pu 239 in soil at present results mainly from the fallout due to nuclear bomb test explosions. (Auth)

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Ioanid, G., G. Mastacan, P. Bunus, M. Popesco, S. Stanciu, and A. Ciccanel, An Investigation on the Use of Romanian Clays as Ion Exchangers in the Decontamination of Radioactive Wastes. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18 (p. 598-604), 624 p. (Institut de Recherches Chimiques, Bucharest, Rumania)

The behavior of some Rumanian clays as ion exchangers for Sr 90 and Cs 137 was reviewed. A discussion is given of the research on the processing and regeneration possibilities of such clays as were found to be active. Their characteristics are further interpreted through a mineralogical study. (Auth)

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Israel, H., and R. Haas, Absorption of Natural

<550> CONT.

Fallout in Soil. 1962. Z. Geophys., 28, 289-292 (Meteorologisches Observatorium des Deutschen Wetterdienstes, Aachen, German Federal Republic)

It is shown by laboratory experiments on the problem of fall-out distribution in soil that radioactivity is absorbed in the uppermost layers of the ground. The measurements were made by sprinkling water activated with (Pb 212) on different types of soil. The distributions in the soil are found to be very similar to those of the Sr 90 fallout. By these results the conclusion is justified that Pb 212 can be used as tracer to detect the fall-out distribution in soil. (Auth)

<551>

Ivanov, S.N., and N.P. Nikitenko, Effect of Soil Conditions and Potassium Supply on the Uptake and Distribution of Rubidium 86 in the Organs of Corn Plants. 1972, February. Dokl. Akad. Nauk BSSR, 16, 141-143

The uptake of Rb 86 by the entire corn plant and by its tissues in less fertile soils with low exchange potassium content proceeds at a higher rate than in soils which are well-fertilized and contain considerable exchange potassium. In well-limed soils, Rb 86 uptake by corn is 1.5 to 2 times lower per unit weight than in unlimed. In the stalking phase the Rb 86 content in the stems is 1.5 to 2 times greater than in the leaves. With the appearance of the reproductive organs the Rb 86 content per unit weight of biomass is distributed as follows: highest in the panicle, then the leaves, and least in the stems. (NSA)

<552>

Ivanov, S.N., and E.D. Shagalova, Ratio of Strontium 90 and Calcium in Certain Mineral and Peat-Swampy Soils. 1969, March. Dokl. Akad. Nauk BSSR, 13, 269-271

The uptake of strontium 90 by plants is not only dependent on the Sr 90 in soils, but also the Ca content. The ratio of Sr 90 and calcium is expressed in strontium units (CE). Even though there is a higher strontium 90 content in peat soils than in mineral soils, the uptake of strontium 90 is lesser in the peat soils. There is a higher CE index in sandy soils than in loam or turf soils. (tr-Auth)

<553>

Ivanov, S.N., E.D. Shagalova, and S.S. Shifrina, Strontium 90 Content of Peat-Bog Soils. 1970, September. Dokl. Akad. Nauk BSSR, 14, 849-852 (Institute of Soil Studies and Agrochemistry, Minsk, USSR)

The Sr 90 content and its behavior in peat-bog soils were investigated. It was found that Sr 90 permeates more deeply in lowland peat-bog soils than in mineral soils. Such vertical migration of the activity increases with the degree of swampiness of the turf. In higher, transitional types of bog, Sr 90 largely precipitates from sediments brought in as a result of surface water runoff, and becomes fixed in the upper mossy layer of the soil. (tr-Auth)

<554>

Ivanov, S.N., E.D. Shagalova, and S.S. Shifrina, Effects of the Agrochemical Properties of Soil on the Uptake of Strontium 90 by Cereal Crops. 1970, April. Dokl. Akad. Nauk BSSR, 14, 355-358

(Institute of Soil Studies and Agrochemistry, Minsk, USSR)

The relation between the agrochemical properties of the soil and the uptake of Sr 90 by winter rye, barley, and oats was investigated. A negative correlation was established between the exchangeable acidity of the soil and Sr 90 accumulation in the grain and straw, and also between the degree of soil saturation by bases and the content of Sr 90 in the grain and the straw of the crops. Expressed either as pCi/kg of plant mass or as Sr units, the high coefficient of correlation is evidence of the validity of the relation between the indexes. (tr-Auth)

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Ivanov, S.N., E.D. Shagalova, and S.S. Shifrina, Forms of Calcium in Soils and Strontium 90 Content in Grain Crops. 1971, November. Dokl. Akad. Nauk BSSR, 15, 1031-1033

The Ca contained in soil has a definite effect on the uptake of Sr 90 by agricultural plants used for production of grain. A well-defined correlation exists between the Sr 90 content in plants and the content of exchangeable Ca in soil. Such a relation does not exist between Sr 90 and the acid-soluble Ca in a soil. Thus, for the Sr 90 content of a plant product such as grain, expressed in strontium units, the quantity of exchangeable Ca in the soil is the decisive factor. (NSA)

<556>

Ivanov, S.N., E.D. Shagalova, and S.S. Shifrina, Effect of Biological Properties of Plants on Strontium 90 Contents in Yield. 1970. Dokl. Akad. Nauk BSSR, 14, 947-950 (Belorussian Research Institute of Soil Studies and Agrochemistry, Minsk, USSR)

Comparative studies were made of the accumulation of Sr 90 in harvested agricultural plants grown under identical conditions. It was shown that Sr 90 uptake depended on biological properties of the plants. Lupine, corn, vetch (VECLA 1), clover, and timothy grass contained more Sr 90 per unit of dry substance than winter rye, barley and oats. Strontium 90 loss was greater from the vegetative parts than the reproductive parts. Calcium retention did not appreciably affect Sr 90 contents or distribution. (NSA)

<557>

Iwai, S., Y. Inoue, and K. Nishimaki, Movement Through Soil of Radioactive Nuclides Contained in Chemical Processing Waste. 1968, August. Nippon Genshiryoku Gakkaishi, 10, 435-440 (Kyoto University, Kyoto, Japan)

The movement through soil of radioactive nuclides contained in chemical processing waste was investigated. Theories governing this movement were reviewed. Experiments were carried out with Sr 90 and Cs 137 in 1N HNO3 to simulate waste. This simulated waste was passed through a column packed with sand and the behavior of these radionuclides in the column was observed. The breakthrough curve of Sr 90 was very similar to the curve of the waste, while Cs 137 showed a curve about 60 times slower than the waste. It can thus be concluded that Sr 90 in actual wastes travels with the ground water, while Cs 137 moves about 60 times slower. (Auth)

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Iwakura, T., A. Oda, S. Miyahara, Y. Kasida, and

<558> CONT.

O. Yamada, Recent Radiocarbon in Plants. 1966. J. Radiat. Res., 7, 134-141 (National Institute of Radiological Sciences, Chiba, Japan; Shizuoka College of Pharmacy, Shizuoka, Japan)

A liquid scintillation counter was used to determine the C 14 content of ethanol extracted from cane sugar and sweet potatoes, of thymol extracted from *ORTHODON JAPONICUM*, and of menthol from *MENTA ARVENSIS*. Tables are presented to show results for ethanol content from 1948 to 1965, for thymol content from 1954 to 1965, and for menthol content from 1942 to 1965. Carbon 14 activity began to increase in 1957 and a peak, 80 percent above normal, occurred in 1963 that was caused by large scale nuclear explosions near the end of 1962. (NSA)

<559>

Iwashima, K., Analytical Methods for Ruthenium 106 in Marine Samples. 1972. J. Radiat. Res., 13, 127-148 (Institute of Public Health, Tokyo, Japan)

Analyses for Ru 106 in marine environmental samples, which are useful for monitoring within a control context, were developed. The quantity and the quality of the samples applied for the analyses are as follows: two l of seawater filtered through a millipore filter of 0.45 μ m pore size; two g (wet weight) of bottom sediments prepared by sieving in seawater; or the edible part of marine organisms equivalent to about 1 g ash. In order to equilibrate Ru 106 in the samples with ruthenium carrier and to dissolve the samples completely, marine organisms and sediments were ashed at 400 to 500 C, and then fused with a mixture of potassium hydroxide and potassium nitrate. Seawater was heated in the presence of an oxidant in an alkaline medium. Ruthenium was extracted with carbon tetrachloride as ruthenium tetroxide, and then back-extracted with sodium hydroxide solution containing a reducing agent. Hydrous ruthenium oxides were precipitated from the extract and subjected to beta-activity measurement with a low background gas-flow counter by use of a 40 mg/cm² aluminum absorber. The loss of ruthenium throughout ashing and chemical procedures was found to be negligibly small by a tracer experiment. Chemical yields were 89 plus or minus 5% and the ratio of chemical and radiochemical yields was 0.98 plus or minus 0.03. Sensitivity of the method (3 sigma) is 0.2 pCi and the whole chemical procedure takes 3 to 4 hours. A rapid gamma spectrometric technique for Ru 106 was also developed in which Ru 106 was coprecipitated with cobalt sulfide from seawater. (Auth)

<560>

Iwashima, K., and N. Yamagata, Environmental Contamination with Radioruthenium, 1961-1965. 1966. J. Radiat. Res., 7, 91-111 (Institute of Public Health, Department of Radiological Health, Minato-ku, Tokyo, Japan)

The results of measurements of medium lived Ru 103 and Ru 106 in air-borne particles, fall-out, surface soil, river water, sea-water, foodstuffs, complete diet and human muscle and lungs during 1961-1965 are summarized. The main passage route of Ru 103 was found to be through the fresh leafy vegetables, while Ru 106 was supplied in a different way, i.e., 77 percent by plant materials raised on land, 6 percent by foodstuffs of animal origin and the remainder by seaweed; the concentration was the highest

in the last item. Estimation of lung and body burdens was performed on the basis of observed data for inhalation and ingestion and compared with the result of measurements on human materials obtained from cadavers. The mobility of fall-out ruthenium in the sequence between precipitation and run-off from rivers seemed a little larger than strontium and much larger than cesium, reaching 14 percent of fresh fall-out delivered to the sea. Average concentration factor from sea-water to sea food as a whole was found to be 70. The equivalent daily intake of sea-water would be 7 kg. On this basis, the maximum permissible concentration of Ru 106 in sea-water was suggested as 3×10^{-6} microCi/ml. (Auth)

<561>

Iyengar, M.A.R., and P.M. Markose, An Investigation into the Distribution of Uranium and Daughters in the Environment of a Uranium Ore Processing Facility. 1971. CONF-701227; Part of Proceedings of a Symposium on Radiation and Radioisotopes in Soil Studies and Plant Nutrition held in Bangalore, India, December 21, 1970. Department of Atomic Energy, Bombay, India, (p. 143-153) (Bhabha Atomic Research Centre, Bombay, India)

Tabulated data are presented from the monitoring of radioactivity in soil, water, air, foodstuffs, and vegetation near the uranium mining and processing facility at Jaduguda, Bihar (India). The concentration of activity in soil patches adjacent to the river banks on the mill and mine premises was evident from the study. Air activity due to radon was found to be significantly higher than in Trombay and Alwaye, the two other centers handling considerable quantities of uranium-bearing ores. Water activity was found to vary widely depending on its radionuclide content. The wide range of concentration in foodstuffs is perhaps due to the varying radioisotope concentrations in different media. The hazards of utilizing the mine stream for domestic cultivation of vegetables and fishing were demonstrated. Algae is a good indicator organism in water pollution. The foodstuffs survey has not led to any selective indicator to aid in the radiological monitoring program. (Auth)

<562>

Jackson, M.L., and J.K. Syers, Technical Progress Report. 1972. COO-1515-41; 20 p. (University of Wisconsin, Department of Soil Science, Madison, WI)

Scientific knowledge has been advanced in the following subject matter areas: 1) Blister-like areas were induced according to degree of hydration of cations through osmotic swelling in low charge areas of micaceous vermiculite basal cleavages. This phenomenon occurred after washing out the excess salts of the saturating cations in the lyotropic series: $Li(+1) > Na(+1) > Be(+2) > Mg(+2) > Ca(+2)$. No other cation induced this type of swelling. 2) Specific sorption of Sr 90(+2) and Ca 45(+2) in the presence of 1N NaOH(3) was traced to proton replacement in solid surface functional groups of hydrous metal oxides of Fe and Al in gel form. The sorption was greatly influenced by the pH of the solutions and sorption influenced the charge of the gel. Amorphous coatings of such materials were previously found on the surfaces of micaceous vermiculites. 3) Perforations such as holes and cracks in micaceous vermiculites caused by fission of U 238 in the crystal layers were found by scanning electron microscopy. Coatings and

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crusts of Fe and Al hydrous oxides may have been formed by diffusion through these crystal defects. Ultramicrotomy and high resolution electron microscopy permitted direct photography of layers and interlayers of phyllosilicates. The defects are expected to affect the weathering release of K(+1) and fixation of exchangeable cation species such as Cs 137(+1). 4) The aerosollic (tropospheric) dusts, found in this project by the use of the oxygen isotope composition of the mineral quartz to have accreted in soils and sediments in a wide range of locations throughout the world, have been shown to contain micaceous vermiculite which is responsible for the sorption and strong fixation of Cs 137(+1). The dusts, which vary in their Cs 137(+1) content depending on locality and time of deposition, all sorbed significant amounts of added Cs 137(+1) and strongly fixed it against replacement by Ca(+2) in 0.01N CaCl₂(2) solution used to simulate natural soil conditions. Eolian influenced soils developed in basalt in Australia were much less effective in fixing Cs 137(+1) and Sr 90(+2) against this extractant. (Auth)

<563>

Jackson, W.E., R.H. Miller, and E.E. Franklin. The Influence of Vesicular-Arbuscular Mycorrhizae on Uptake of Strontium 90 from Soil by Soybeans. 1973. Soil Biol. Biochem., 5, 205-212 (Ohio State University, Columbus, OH; Ohio Agricultural Research and Development Center, Wooster, OH)

The Stanford-Dement technique was used in a study of the influence of the vesicular-arbuscular (VA) mycorrhizal fungus ENDOGONE MOSSEAE on Sr 90 uptake by soybean. Thirteen-day-old mycorrhizal soybean plants absorbed significantly more Sr 90 than control plants after 1, 3 or 7 days contact with Sr 90 amended sterilized or nonsterilized soil. The same positive influence of ENDOGONE MOSSEAE on Sr absorption was observed in a second study which allowed for Sr 90 uptake concurrent with mycorrhizal infection and development. In the Stanford-Dement study, soil sterilization exerted a short (1 day) negative influence on the uptake of Sr 90 by mycorrhizal roots. In the second study, mycorrhizal roots absorbed more Sr 90 from sterilized soil than from unsterilized soil while the reverse occurred with the control plants. Infected plants in both studies showed an early decrease in dry matter yield. (Auth)

<564>

Jackson, W.A., Nitrogen Absorption and Strontium Accumulation, Annual Progress Report, August 1, 1972 - July 31, 1973. 1973. ORO-2410-24; 41 p. (North Carolina State University, Raleigh, NC)

Nitrate efflux studies with wheat plants previously grown with nitrate revealed significant and prolonged efflux could occur to solutions of 0.1 mM CaSO₄ alone or with 1 mM KCl or K₂CO₃. The quantity of endogenous nitrate efflux, however, was increased when plants were exposed to 1 mM K 15 labeled KNO₃ highly enriched in N 15. Decreased N 15 labeled NO₃ influx occurred when plants were grown with progressively higher nitrate concentrations prior to the experimental period. Increases in N 14 labeled NO₃ efflux from these plants did not parallel the decreases in N 15 labeled NO₃ influx. The data are considered to support a two component model of net nitrate uptake. The decline in net nitrate uptake which occurs during the intermediate state (2-4 days) of recovery from

nitrogen deficiency could not be explained as simply a result of a high endogenous root nitrate concentration. Present evidence suggests that these plants may have limiting rates of carbohydrate translocation to their root systems although experiments with N 15 labeled NO₂ reveal that they can assimilate nitrite readily and other evidence suggests their nitrate reduction capacity is substantial. Translocation of nitrate to the root xylem vessels is rapidly restricted upon removal of ambient nitrate. This occurs even when relatively high nitrate concentrations exist in the root tissue thus supporting the concept that much of the root nitrate is only slowly available to the translocation pool. Amino acid translocation to the xylem is enhanced shortly after exposure to ambient nitrate and is restricted shortly after transfer to nitrate-free media indicating a close dependency on simultaneous nitrate uptake for nitrate reduction and/or stimulation of the amino acid transporting system. (Auth)

<565>

Jackson, W.A., Nitrate Absorption and Strontium Accumulation, Summary Report, May 1, 1971 - July 31, 1973. 1973. April. ORO-2410-15; 7 p. (North Carolina State University, Raleigh, NC)

Experiments with highly enriched N 15-nitrate involving aeration, temperature, composition of the ambient medium and prior exposure to variable nitrate, all tended to support a model of nitrate uptake which visualizes an energy dependent active transport mechanism, a bidirectional leakage process, and a recycling of nitrate ions from the leakage pores to the absorption sites within the outer levels adjacent to the plasmalemma of root cortical cells. Development of an accelerated rate of net nitrate uptake upon first exposure to nitrate could not be hastened by prior exposure to ammonium, was restricted by pretreatments with nitrite, depended upon compounds imported from tissue other than roots and was restricted by RNA- and protein-synthesis inhibitors. Studies with N 15-nitrate revealed that nitrate accumulation in the tissue was restricted by the inhibitors more than was nitrate reduction. The data support the concept that a specific nitrate transport protein is synthesized upon exposure to nitrate. In wheat plants enhancement of strontium and calcium translocation by various nitrogen treatments was associated with discrimination against strontium. It was proposed that nitrate treatments enhanced the apoplastic transport of the divalent cations across the root tissue and experiments with exuding corn plants were initiated to test this hypothesis. (Auth)

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Jackson, W.A., Nitrate Absorption and Strontium Accumulation, Annual Progress Report, August 1, 1973 - July 31, 1974. 1974. ORO-2410-29; 77p. (North Carolina State University, Raleigh, NC)

Displacement of previously absorbed Sr 85 and Ca 45 to unlabeled solutions and translocation of these ions to the exuding xylem sap of dark grown decapitated corn seedlings revealed distinctly different degrees of accumulation in compartments of the root tissue. Relative enrichment in Sr 85 was observed in the displaced material, the enrichment rising with successive fractions displaced over a four hour period. In contrast, the Sr 85/Ca 45 ratio of the exuding vascular exudate was less than that of the root tissue. Nitrate, compared to chloride, resulted in an increase

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in the Sr 85/Ca 45 ratio displaced from the roots but the nitrate treatment maintained a lower ratio in the vascular exudate toward the latter part of the displacement period. (Auth)

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Jackson, W.A., D. Craig, and H.M. Lugo, Effects of Various Cations on Cesium Uptake from Soils and Clay Suspensions. 1965. Soil Science, 99, 345-353 (North Carolina State College, Raleigh, NC)

The effects of ammonium, potassium, and rubidium on the uptake of cesium 137 by wheat from suspensions of soil and reference clay minerals were examined. Cesium 137 uptake was depressed by potassium, increased by ammonium, and unchanged by rubidium except at high concentrations. (CNF)

<568>

Jackson, W.A., H.M. Lugo, and D. Craig, Cesium Uptake from Dilute Solutions by Young Wheat Seedlings as Affected by Selected Cations. 1966. Plant and Soil, 24, 33-53 (North Carolina State of the University of North Carolina, Agricultural Experiment Station, Department of Soil Science, Raleigh, NC)

Experiments were conducted with young wheat seedlings to determine the effects of selected cations on Cs uptake by roots and on transport to shoots. The experiments were conducted in dilute, slowly stirred solutions. Uptake by roots was reduced by prior K treatment and simultaneous presence of K, Rb, and NH₄. Addition of Ca at pH 4 increased Cs uptake by roots. Transport to shoots was reduced by Ca at pH 6, by NH₄, and by K and Rb when the K content of the tissue was high. When the K content of the tissue was low, little Cs transport occurred and solution concentrations of K up to 0.01 mequiv per liter increased Cs-transport. The data suggest that separate processes were involved in Cs uptake and transport with competition existing between the two processes for the entering Cs. Ammonium ions inhibited both uptake and transport to about the same extent whereas K inhibited uptake more than transport. (Auth)

<569>

Jackson, W.A., and D.C. Williams, Nitrate-Simulated Uptake and Transport of Strontium and Other Cations. 1968. Soil Science Society of America Proceedings, 32, 698-704 (North Carolina State University, Agricultural Experiment Station, Raleigh, NC)

Supplying nitrate to N-depleted wheat seedlings (TRITICUM VULGARE, var. Atlas 66) stimulated the uptake of both divalent (Sr, Mn, and Mg) and monovalent (Cs, Na, K) cations. Rapid nitrate uptake, and the lower ambient acidity resulting from it, appeared to be partially responsible for the increase in cation uptake. Nevertheless, pretreatments with nitrate exerted some stimulation in Sr and Cs uptake, indicating an additional action of nitrate after it had entered the tissues. Pretreatment with nitrate, as well as its presence during the Sr uptake period, increased transport of Sr to the shoots more than total uptake. Transport to shoots of previously absorbed Sr was enhanced by subsequent nitrate treatments, the amount transported being significantly greater with nitrate salts of Ca, Mg, and Na than with K or NH₄. (Auth)

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Jackson, W.A., D.C. Williams, and P.L. Minotti, Some Consequences of Nitrogen Nutrition on Uptake and Transport of Strontium and Cesium. 1968. Soil Science, 106, 381-392 (North Carolina State University, Agricultural Experiment Station, Raleigh, NC)

The influence of ammonium and nitrate nitrogen was investigated on the uptake of strontium 85 and cesium 137. In the wheat seedlings over a two week growth period the absorbed strontium was transported to the shoots to a greater extent in cultures which contained either ammonium or nitrate nitrogen than those with no nitrogen. Ammonium depresses uptake of Cs 137 in ammonium deficient wheat seedlings (pre treatment). (CNF)

<571>

Jacobs, D.G., Ion Exchange in the Deep-Well Disposal of Radioactive Wastes. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962, (p. 43-54) (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Exchange of monovalent and divalent cations on numerous reference clay minerals and sandstones shows that the exchange potentials of the divalent alkaline earth cations are quite similar. Strontium is selectively sorbed over calcium by a factor of 1.25. Divalent cations are sorbed in preference to sodium by the clay minerals and the exchange is adequately described by the laws of mass action when the divalent cations occupy more than 15% of the total exchange sites. The sorption of trace quantities of strontium from a calcium-free sodium salt solution is greater than predicted for simple ion exchange, suggesting the presence of small quantities of sorption sites highly selective for divalent cations. Normalized strontium breakthrough curves coincide with normalized chloride breakthrough curves and show that radionuclide migration can be predicted by observing the dispersion of water in the disposal formation and correcting for the sorptive behavior of specific radionuclides. Exchange studies with Richfield sand, a typical deep-well disposal formation, suggest that in the disposal of ORNL low-level and intermediate-level wastes strontium will move only 1% and 10% as fast, respectively, as the transporting water due to ion exchange; calcium-strontium precipitation reactions will provide additional restrictions to radiostrontium movement. Cesium would move much more slowly than strontium because of highly selective exchange reactions. Ruthenium may move rapidly but is not likely to be hazard controlling. (Auth)

<572>

Jacobs, D.G., Movement of Radionuclides through the Ground. 1963. Nuclear Safety, 5, 109-114 (Oak Ridge National Laboratory, Oak Ridge, TN)

Four general approaches for comparing the migration of radionuclides in the ground with the movement and dispersion of the transporting water involve its correlation with a qualitative description of water movement, a classical hydrodynamic description of the receiving formation, direct measurement of the hydraulic dispersion using an appropriate water tracer to obtain the solution velocity distribution, and a quantitative description of the various factors affecting radionuclide movement and dispersion. The primary concern is to describe

<572> CONT.

the variation of activity in the solution phase with time and distance. (NSA)

<573>

Jacobs, D.G., Use of Negative Sorption in Studies of Ion Fixation by Hydrobiotite. 1964. ORNL-P-573; CONF-770-1; Part of Proceedings of the Clay Mineral Society held in Madison, Wisconsin, October, 1964 (Oak Ridge National Laboratory, Oak Ridge, TN)

The mechanisms relative to the cesium fixation in hydrobiotite from South Carolina were explained. The author concluded that two distinct minerals are present in the hydrobiotite from the quantities of cesium entrapped since the quantities fixed are related to the interlayer surface charge densities of the minerals. (CWF)

<574>

Jacobs, D.G., Sorption of Cesium by Conasauga Shale. 1960. Health Physics, 4, 157-163 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Conasauga shale has been found to be effective for removal of cesium from the waste stream. The partial cesium capacity of the shale was found to be dependent on the nature and concentration of the major stable cations present in the waste. The capacity of the shale for "fixation" of cesium greatly exceeds the capacity of the shale for sorption of cesium from the waste stream; thus, the cesium retained from the waste stream would be very difficult to remove from the formation by percolating ground water. Because fixation sites incorporate charge deficiency with structural parameters, removal of cesium from the shale is increased by increasing the concentration of cations in the leaching solution. (Auth)

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Jacobs, D.G., Strontium Movement in Soil. 1960. Nuclear Safety, 2, 63-65 (Oak Ridge National Laboratory, Oak Ridge, TN)

A short review concerning mechanisms of strontium adsorption reactions and movement through soil is presented. (CWF)

<576>

Jacobs, D.G., Cesium Exchange Properties of Vermiculite. 1962. Nucl. Sci. Eng., 12, 285-292 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Although direct disposal to the ground has provided an effective means for the disposal of low and intermediate-level waste streams, there is concern regarding the lack of control of the radionuclides once the wastes have been discharged to the ground. The use of a mineral-filled column is regarded as an inexpensive, yet efficient, alternative method for waste decontamination. For this purpose the cesium-exchange properties of various grades of commercially available vermiculite were investigated and compared to other natural ion-exchange materials. Elucidation of the reaction mechanism has led to improvement of the cesium-sorptive properties, either by potassium treatment or heat treatment of the vermiculite or by addition of potassium to the waste stream. Studies of the kinetics and the thermodynamics of the exchange reaction permit extrapolation of the data for consideration of the extended use of

vermiculite columns for decontaminating other waste streams. Data obtained from bench-scale and field-scale (10-ft long, 2-in. i.d.) column studies compare closely with those obtained by slurry studies. The breakthrough curves obtained were sufficiently steep to indicate that the partial cesium-sorptive capacity of a vermiculite column would be completely utilized if two columns were operated in series. A column 10 ft long and 10 ft in diameter filled with Na-treated vermiculite is estimated to be capable of decontaminating more than 5×10^5 gal of ORNL intermediate-level waste. Larger volumes of waste streams having lower concentrations of stable salts could be decontaminated with respect to cesium and strontium. (Auth)

<577>

Jacobs, D.G., and T. Tamura, Study of the Parameters of Radicobalt Transfer in Continental Aquatic and Irrigated Ecosystems. 1960. EUR-4628; CEA-R-4151; 36 p. (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Fontenay-aux-Roses, France)

A short review of the literature pertaining to use of soil as a repository of radioactive wastes is presented. (CWF)

<578>

Jacobson, L., and E. Overstreet, The Mechanism and Kinetics of Mineral Absorption by Plants. 1967. UCB-34P5-47; Annual Progress Report, 15 p. (University of California, Department of Soils and Plant Nutrition, Berkeley, CA)

Progress is report on the following studies: uptake of cations by roots of plants in CO₂ and in air; effects of inhibition of oxidative phosphorylation on oxygen uptake; effects of CO₂ on anion uptake by roots; uptake of sodium, potassium, and rubidium by CHLORELLA PYRENOIDOSA; effects of hydrogen and calcium ions on loss of potassium ions by tissues of ZEA MAYS; and effects of oxygen on loss of potassium ions by tissues of barley and maize. (NSA)

<579>

Jacobson, L., and E. Overstreet, A Study of the Mechanism of Ion Absorption by Plant Roots Using Radioactive Elements. 1947. American Journal of Botany, 34, 415-520 (University of California, Division of Plant Nutrition, Berkeley, CA)

Sectioning experiments, of both dead and live barley roots showed maximum absorption of strontium and iodine occurred within a few millimeters of the root apex. In live roots at 0 degrees centigrade the magnitude was much greater than in the dead roots. Data indicated the formation of ion-binding substances in the protoplasm during aerobic metabolism. (CWF)

<580>

Jacobson, L., and E. Overstreet, The Uptake by Plants of Plutonium and Some Products of Nuclear Fission Adsorbed on Soil Colloids. 1948. Soil Science, 65, 129-134 (University of California, Berkeley, CA)

Barley and pea plants have been found to take up the fission elements Y, Ce, Zr+Cb, Te, Sr, and the three valence states of Pu, even when these elements are present in trace amounts on the surfaces of clay or soil particles. For all the elements tested, the greatest fixation is in or on the roots. With the exception of Sr, translocation occurs only to a limited

<580> CONT.

The translocation of Sr is relatively large. Activity levels of 0.1 microcurie per gram soil are sufficient to cause very pronounced injury over a 3-month period. (auth)

<581>

Jennings, A.R., and M.C. Schroeder, Laboratory Evaluation of Selected Radioisotopes as Groundwater Tracers. 1968, August. Water Resour. Res., 4, 829-838 (Texas A&M University, College Station, TX)

Choice of radioisotopes for following ground-water flow is discussed. The radioisotopes used should be either in anionic or nonionic form, as cations are most susceptible to ion exchange. The choice of anionic radioisotopes for ground-water tracers is limited because of the half-life, type, and energy of the radiation emitted, and in some cases the chemical complexity of the isotope. A suitable detection time for radioisotopic tracers is from 3 to 5 half-lives. As the appearance of a tracer results from movement along the most direct flow path, the arrival of the maximum concentration is the best index for determining the average water velocity. Antimony 121, Ce 141, Cr 51, Ir 192, Ru 103, and Sr 89 in chelate form were tested, as the unchelated ions are subject to greater delay by adsorption and ion exchange. Distribution-coefficient measurements were made under static conditions for crushed illitic shale and limestone, and these measurements used to predict the elution history of a tracer from an exchange column. Comparisons of the predictions, the tracer elution histories, and elution histories for chloride pulses indicated chelated Cr 51 to be a useful ground-water tracer. (NSA)

<582>

Johannsen, K.H., and W. Lenk, Sorption of Radionuclides on Friable Soils and other Natural Absorbents. 1969. SES-6/69; 33 p. (Staatliche Zentrale fuer Strahlenschutz, Berlin, German Democratic Republic)

The decontamination efficiency of 5 typical soils, browncoal, and sawdust was investigated for waters containing radionuclides. The dependence on pH, carrier concentration, and time of the distribution ratios of Ce 144, Cs 137, I 131, Ru 106, Sr 89, Co 60, and fission products was determined by shaking. The highest distribution ratios (100 to 1000) were obtained with soils containing clay or humic acids. The pH was of no important influence on the adsorption in the pH range 4 to 10. On the average the highest distribution ratios were obtained in this range. The strength of adsorption decreased in the following order: Ce > Sr > Cs > Ru > I. The results show that with soils, even in amounts of 10 to 100 g/l it is not possible to get decontamination effects in the order of magnitudes. Moreover it is difficult to handle soils in water treatment plants. In accidental situations however waste disposal into the ground is more convenient than disposal into surface waters. (auth)

<583>

Johanson, H.M., and R.H. Wilson, Strontium (+2) Uptake by Bean Mitochondria. 1971. Radiation Botany, 11, 283-286 (University of Texas, Department of Botany, Austin, TX)

Isolated bean mitochondria were shown to accumulate up to 400 nmoles Sr(+2)/mg protein.

The uptake was supported by a number of substrates and was dependent on isolation of tightly coupled mitochondria. The results indicate that plant mitochondria can accumulate significant amounts of Sr(+2) and this may influence its mobility in plant tissue. (Auth)

<584>

Jones, G.B., and G.E. Belling, The Movement of Copper, Molybdenum, and Selenium in Soils as Indicated by Radioactive Isotopes. 1967, September. Aust. J. Agr. Res., 18, 733-740 (Commonwealth Scientific and Industrial Organization, Adelaide, Australia)

Copper 64, Mo 99, and Se 75 were applied to various soils to study their movement under the influence of various fertilizer treatments. With soils of moderate exchange capacity, Cu 64 remained near the surface following all fertilizer treatments and the equivalent of several years' rainfall. With light soils of low exchange capacity some penetration of Cu 64 occurred, especially following superphosphate and an aqueous extract of lucerne. With Mo 99, in general, a high proportion was leached right through the soils, except in the case of the 2 laterite soils examined, where up to half of the Mo 99 was retained near the surface. Selenium 75 applied as sodium selenite was intermediate between the extremes illustrated by Cu 64 and Mo 99, in that a high proportion was retained by the calcareous soils but not necessarily at the surface. The lighter soils retained a much lower proportion of selenium. (NSA)

<585>

Jones, G.B., D.S. Ficeman, and J.O. McKenzie, The Movement of Cobalt and Zinc in Soils as Indicated by Radioactive Isotopes. 1957. Aust. J. Agr. Res., 8, 190-201 (University of Adelaide, Division of Biochemistry and General Nutrition, Adelaide, Australia)

A method has been developed whereby labeled cobalt and zinc were applied to the surface of columns of soil in order to study the movement of these cations under the influence of rainfall and various fertilizer treatments. The results of the investigation demonstrate that in soils of moderate exchange capacity, whether this is provided by clay or by organic matter, the cobalt and zinc remain close to the surface of the soil even after the application of water equivalent to several years' rainfall and dressings of copper sulphate, superphosphate, aqueous extract of lucerne, and water saturated with carbon dioxide. With very light soils of low exchange capacity a year's rainfall alone did not leach the cobalt or zinc downwards, but rainfall which followed treatments with the same treatments with the same dressings induced a considerable downward movement of both cobalt and zinc. (CWF)

<586>

Jones, J.B., Jr., and F. Haghir, Reducing the Uptake of Strontium 90 by Plants on Contaminated Soils. 1962. Ohio Journal of Science, 62, 97-100 (Ohio Agricultural Experiment Station, Department of Agronomy, Wooster, OH)

The effects of soil type, pH, and calcium content on the uptake of radiostrontium by four crops: wheat, alfalfa, corn, and soybeans were evaluated. The strontium 90 concentration of the various plant species was found to decrease in the order: soybean > corn approximately equals alfalfa > wheat. Raising

<586> CONT.

the soil pH from 5.0 to 7.0 decreases strontium 90 concentrations in all crops by approximately one-half. (CWF)

<587>

Jones, P.H., and H.E. Skibitzke, Film: Dispersion of Aqueous Radioactive Waste in a Heterogeneous Aquifer. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (U.S. Geological Survey, Water Resources Division, Washington, DC)

A routine discharge of 203 curies of tritium to a disposal well at the Idaho Chemical Processing Plant, National Reactor Testing Station, United States Atomic Energy Commission, after a 10 month shut down of the plant, provided an opportunity to trace the movement of the waste water through an aquifer selectively tapped by 14 observation wells at distances of 703 to 3,502 feet from the disposal well. Accurate maps of head distribution in the aquifer during and following the discharge have been made, and the thickness of the aquifer has been mapped. Predictions of the paths of waste movement in the aquifer based upon conventional analysis of the piezometric maps were grossly in error; but a prediction based on analysis of the map of aquifer thickness was well substantiated. A series of hydraulic models were constructed to duplicate field conditions, and dye tracers were injected into through-flowing water at the disposal point. The movement and dispersion of the dye stream closely simulated the field pattern. The path of flow, the dispersion fan, and the rate of attenuation of the concentration of the waste water were found to be relatively independent of the ratio of the rate of disposal discharge to the rate of flow of groundwater in the aquifer. (Auth)

<588>

Jordan, C.F., Movement of Strontium 85 and Cesium 134 by the Soil Water of a Tropical Rain Forest. TID-24270: Part of Odum, H.T. and Pigeon, R.F. (Eds.), A Tropical Rain Forest, (p. H. 201-204) Puerto Rico Nuclear Center, Rio Piedras, Puerto Rico)

Radioactive strontium and cesium were used to tag waters applied to rain forest plots under which were located lysimeters at litter level and at a 5-in. depth within the mineral soil. After 6 months only 33 percent of the strontium and 27 percent of the cesium had moved out of the litter. Less than 1 percent of each had reached the deeper lysimeters. Changes in the rate of release of these elements with time suggest the effectiveness of the litter layer in retaining minerals. (Auth)

<589>

Joshi, L.U., C. Rangarajan, and S.S. Gopalakrishnan, Investigations on Lead 210 Concentrations in Various Regions of India. 1971. Health Physics, 20, 665-668 (Bhabha Atomic Research Centre, Bombay, India)

Seasonal measurements of Pb 210 were carried out to explore the possibility of increased Pb 210 levels resulting from high uranium or Ra 224 activity of the soil. Seasonal variations of Pb 210 were measured at Srirangar, Delhi, and at Mairital where results did not show a pronounced variation. The radon daughter activity was compared with that of Pb 210 at

Bombay and the latitudinal variation of Pb 210 was plotted in surface air and rainfall. At Gangtok the results were higher than a factor of 2, than those of the other stations, the increase occurring mainly in the winter months, and not apparently due to a significant increase in Ra 226 in the soil. (NSA)

<590>

Juo, A.S.R., and S.A. Barber, Reaction of Strontium with Humic Acid. 1969. Soil Science, 108, 89-94 (Purdue University, Lafayette, IN)

A radioactive tracer study using Sr 89 showed strong retention of Sr by humic acid. The reactivity of Sr with the various oxygen-containing functional groups was investigated with IR spectroscopy. The results for humic acid were compared with the reactivity of Sr with known functional groups in graphitic acid, carboxylic acid exchange resin, and 1-hydroxy-2-acetonaphthone. These IR investigations suggest that the reaction of Sr differed according to the type of reaction site on humic acid. The more acidic carboxyl groups reacted readily with Sr when humic acid was suspended in chloride solution. The weak carboxyl groups reacted with Sr only when humic acid was brought into solution with dilute NaOH. It is postulated that Sr may also form insoluble coordination linkages with phenolic hydroxyl, ketonic carbonyl as well as carboxyl groups. (Auth)

<591>

Juo, A.S.R., and S.A. Barber, Retention of Strontium by Soils as Influenced by pH, Organic Matter, and Saturation Cations. 1970, March. Soil Science, 109, 143-148 (Purdue University, Lafayette, IN)

Four soils varying greatly in organic matter content, CEC and texture were selected for study. The effects of pH and the kind of saturation cations on the sorption and retention of Sr from a 3×10^{-3} M SrCl₂ solution labeled with Sr 89 were evaluated in terms of equilibrium distribution coefficient, K_d, and by repeated N NH₄Cl extraction. It was found that the sorption of Sr by soils increased with the increase of pH of the system, within the pH range studied (pH 4 to 8). The influence of the kind of saturation cations on the sorption of Sr by soils followed the order of Na>K>Mg>Ca>Ba>H. An increasing proportion of the sorbed Sr remained nonexchangeable with NH₄⁺ as a result of increasing the pH of the system. This was attributed to the organic fraction of the soil. This portion of Sr may be permanently fixed by the soil under favorable pH conditions. It was also found that when an organic soil was brought into a higher pH environment, a significant portion of the Sr in the solution phase of the soil may be present as soluble Sr chelates or complexes rather than as free Sr(+2) ions. However, under normal pH conditions usually found in natural organic soils (pH about 5), the presence of soluble Sr-chelates or complexes in the soil solution should be negligible. (Auth)

<592>

Juo, A.S.R., and S.A. Barber, An Explanation for the Variability in Strontium-Calcium Exchange Selectivity of Soils, Clays and Humic Acid. 1969. Soil Science Society of America Proceedings, 33, 360-363 (Purdue University, Agriculture Experiment Station, Lafayette, IN)

The reason for the variability among soils in

<592> CONT.

their effect on the Sr-Ca exchange selectivity was investigated in systems where Sr and Ca were the only competing ions and Sr was present in small amounts. The exchange selectivity theory of Eisenman was used to explain the results. The dominant factor governing the relative strengths of adsorption by the clay minerals studied was the relative energy of hydration of the two cations, so that Sr, the more weakly hydrated, was adsorbed more strongly than Ca. However, on humic acid, where the carboxyl group was mainly responsible for the exchange adsorption, the field strength of the exchange site was important so that a reversed sequence occurred and Ca was adsorbed more strongly than Sr. Investigations with soils confirmed the results using soil components. As the fraction of Sr on the exchanger phase was reduced, the relative Sr adsorption increased indicating that variable sites were present on all of the materials studied. (Auth)

<593>

Jurinak, J.J., and D.W. Thorne, Zinc Solubility Under Alkaline Conditions in a Zinc-Bentonite System. 1955. Soil Science Society of America Proceedings, 19, 446-448 (Utah State Agriculture College, Department of Agronomy, Logan, UT)

The possibility of zinc formation in alkaline soils has been investigated. Utah bentonite suspensions were titrated to 1/2, 1, and 2 percent of their base-exchange capacities with Zinc 65 in zinc chloride. The pH of the suspensions was varied by treatment with sodium, potassium, or calcium hydroxide. After a period of shaking, the suspensions were centrifuged and the supernatant analyzed for Zinc 65. (Auth) (CWF)

<594>

Kabata-Pendias, A., Notes on Chemical Methods of Determining Available Copper and Cobalt in Soils. 1963. Pam. Pulawski, 9, 1-39

The amounts of Cu extracted from plants and soils (peat, podzol or brown soil developed on loamy sand, sandy loam) with various extractants decreased in the order: plants (mostly clover and grass), 10 percent HCl, 0.1M EDTA, 0.1 M HCl, 2.5 percent CH₃COOH, 0.1 M HNO₃, CH₃COOH + dithizone. The decreasing order for Co was: 10 percent HCl, EDTA, 0.1 M HCl, plants, CH₃COOH + dithizone, CH₃COOH, HNO₃. The proportion of total Cu and Co taken up by plants was greater on mineral soil than peat, but the uptake of Co was fairly uniform. (Soils and Fertilizers)

<595>

Kaddah, M.T., Cesium Uptake by Sudangrass Seedlings from Four Soils in Southern California. 1968, May. Soil Science, 105, 369-375 (University of California, Riverside, CA)

The uptake of Cs added to four soils in micro- and macroamounts in the presence of various salts was studied by a modified Neubauer technique using sudan grass as the testing plant. The amounts of Cs added per 100 g soil varied from 10 (E-7) to 1 meq CsCl. Analysis of the shoots of 10 days old seedlings for Cs showed that little differences were exhibited among the four soils when the Cs additions ranged from 10 (E-7) to 10 (E-2) meq/100 g soil. With increasing Cs addition wide variations occurred among the soils with less Cs taken up from the vermiculitic soils than from the non-vermiculitic soils. Cesium uptake in the second cutting of any treatment was generally

greater than Cs uptake in the first cutting. Cesium toxicity symptoms commenced when the Cs concentration in the shoots was 0.02 to 0.03 meq Cs/g dry shoots. The toxicity symptoms started as blanched, watersoaked areas and as reddish-brown streaks which spread with ultimate drying of the shoots. When Cs was added to soils in microamounts (< 10 (E-4) meq/100g) with different salts, the availability of Cs was influenced by the salt concentration especially by K and NH₄ salts and by the sequence of addition of Cs and K or NH₄ salts. In general, increasing concentration of K ions decreased Cs uptake, whereas NH₄ ions increased Cs uptake in some soils and had little or depressing effect on Cs uptake in other soils. When 0.1 meq CsCl was added to 100 g soils, the enhancing effect of NH₄ ions on Cs absorption did not occur. Increasing concentrations of K or NH₄ ions decreased Cs uptake. The results indicate also that Cs ions under this macro-concentration affected the availability of both K and NH₄ ions. For any concentration of added Cs, the uptake of Cs was higher when it was added after rather than before NH₄ or K ions, especially in vermiculitic soils and with increasing Cs concentration. (Auth)

<596>

Kahn, B., Leaching of Some Fission Products from Soil. 1956. Anal. Chem., 28, 216-218 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

A simple procedure permits the radiochemical determination of radionuclides of cesium, strontium, yttrium, cerium, ruthenium, zirconium, and niobium adsorbed on soil. The procedure consists of leaching the radionuclides with appropriate volumes and concentrations of boiling nitric, oxalic, or sulfuric acid; separation of the radionuclides from nonradioactive ions leached from the soil; and standard radiochemical separations. To determine the leaching efficiency of various solutions, radioactive tracers were adsorbed on Conasauga shale from aqueous solutions and then leached from the shale. It was found that 99 percent of the adsorbed radionuclides could be removed from the soil by the leach solutions. By modifying existing radiochemical procedures, it was possible to remove the contaminating nonradioactive ions leached from the soil and thus obtain the radionuclides free of ions which could interfere with their radiochemical determination. (Auth)

<597>

Kahn, J.S., and J.B. Hanson, The Effect of Calcium on Potassium Accumulation in Corn and Soybean Roots. 1957. Plant Physiology, 32, 312-316 (University of Illinois, Department of Agronomy, Urbana, IL)

A study has been made of the kinetics of K accumulation by corn and soybean roots as affected by Ca. For both kinds of roots, Ca increases the affinity between the K ion and the postulated carrier; in a second reaction, independent of the first, Ca decreases the velocity of the metabolic phase of K uptake. The first effect of Ca is proportionally greater in corn, while the second is proportionally greater in soybeans. The net result of the two effects is to reduce maximum K accumulation in the presence of Ca more in soybeans than in corn. (Auth)

<598>

Kalninya, Z.K., and S.A. Osipenko, Coefficient of

<598> CONT.

Accumulation for Stable Strontium and Strontium 90 in Freshwater Plants and Plankton. 1969. Radiobiologiya, 9, 111-112 (Institute of Biology, Riga, USSR; Institute of Biology, Sevastopol, USSR)

The coefficient of accumulation for stable and radioactive strontium was determined using eight species of freshwater plants and 10 species of plankton. The data indicated that in freshwater species, stable strontium and Sr 90 were accumulated in equilibrium with each other. (NSA)

<599>

Kanath, P.R., A.A. Khan, S.R. Rao, T.M.V. Pillai, M.L. Borkar, and S. Ganapathy, Environmental Natural Radioactivity Measurements at Trombay Establishment. 1964. Part of Adams, J.A.S. and Lowder, W.M. (Eds.), Natural Radiation Environment, University of Chicago Press, Chicago, Illinois, (p. 957-978) (Atomic Energy Establishment, Trombay, India)

Results of systematic environmental radioactivity studies by the Trombay Establishment are reported. Discussions are included concerning radiochemical methods employed in the studies, background radiation near nuclear facilities, waste release effects, and on radioactivity of biological materials, soil, vegetation, and water. (NSA)

<600>

Kampbell, D.H., Cerium, Iron, and Manganese Sorption by Soil Colloids and Uptake by Plants. 1964. Ph.D. Thesis; 136 p. (University of Missouri, Columbia, MO)

Investigations were made to determine the sorption of cerium, iron, and manganese in aqueous suspensions of some common soil colloids by isotopic equilibration with variable factors of acidity, ionic concentration, and chelating agents. All colloidal systems of kaolinite, illite, Putnam, and montmorillonite clays and fibrous peat had a high affinity for cerium. Only under very acid conditions did cerium remain in solution. Cerium was easily replaced from the colloids by hydrogen ions. The chelating agent DTPA was very effective in keeping trace amounts of cerium in solution. More iron than manganese was adsorbed by the colloids. At pH 4 the fibrous peat and illite had the highest affinity for manganese and iron, respectively. Twenty ppm levels of DTPA and EDTA were more effective than NTA in keeping manganese and iron in solution. Greenhouse studies were conducted to determine the influence of acidity, chelating agents, soil colloids, and nutrient solutions on the uptake of cerium, iron, and manganese by young corn plants. The uptake of trace Cerium 144 was greatly reduced by the presence of any colloid. Uptake of differences by equal rates of DTPA, EDDHA, CDTA, Fe-EDTA, and Na-citrate showed that DTPA was most effective in increasing Cerium 144 uptake and that Na-citrate was least effective. Nutrient solution phosphorus increased cerium uptake while nitrogen had no detectable effect. A decrease of pH increased cerium uptake. A plant species difference in cerium uptake occurred with soybeans>peas>wheat>corn or leumes>grasses. Manganese and iron plant uptake studies were conducted with carrier applications of 3 ppm Mn and 3 ppm Fe both as sulfates. The presence of any colloid reduced manganese and iron uptake. In studies with nitrogen and phosphorus nutrient solutions only phosphorus increased iron uptake while manganese uptake

was not effected. (NSA)

<601>

Kamprath, E.J., and C.D. Welch, Retention and Cation Exchange Properties of Organic Matter in Coastal Plain Soils. 1962. Soil Science Society of America Proceedings, 26, 263-265 (North Carolina Agriculture Experiment Station, Department of Soils, Raleigh, NC; North Carolina Department of Agriculture, Raleigh, NC)

Soil organic matter is quite important as a source of cation-exchange capacity in Coastal Plain soils. The amount of organic matter in well-drained soils is directly related to the clay content. In the very poorly drained soils this direct relationship was not apparent. The cation-exchange capacity of soil organic matter varied from 62 to 270 me. per 100 g. The nature of the exchangeable hydrogen of organic matter was measured by the use of several replacing solutions. A portion of the exchangeable hydrogen in soil organic matter was found to come from strong acid groups. (Auth)

<602>

Karavaeva, E.M., and I.V. Molchanova, Uptake of Chemical Analogs (Strontium 90-Calcium and Cesium 137-Phosphorus) by Plants as a Function of Soil Moistness. 1971. Ecology (USSR), 2, 470-473 (Institute of Plant and Animal Ecology, Sverdlovsk, USSR)

Mobility of radioisotopes in a soil-plant system is largely determined by macroamounts of isotopic and nonisotopic carriers in the surroundings. Despite the chemical property similarities of micro- and macrocomponents, elements which are completely analogous in their behavior are not generally seen; even those with quite similar properties can differ in their uptake by plants from soil. The ratio, radioisotope (mCi)/analog (g), has been shown to depend on the type of soil, the combined chemical form of the element, and biological peculiarities of the plant. (Auth)

<603>

Karavaeva, E.M., Effects of Soil Moisture on the Distribution of Sulfur 35 in the Basic Groups of Chemical Compounds of Pea and Pine Plants. 1968. Tr. Inst. Ekol. Rast. Zhivotn., 61, 61-64

Most of the S 35 from soil acting in pea plants and pines, was contained in water-soluble compounds. The distribution of S 35 among the main groups of chemical compounds depended on the specific peculiarities of the plants. The degree of soil moisture had little effect on the distribution of S 35 among the fractions of the chemical compounds of the pea plants and pines. (tr-Auth)

<604>

Kashukeev, N.T., Method for Determination of Microquantities of Uranium in Specimens with Unknown Chemical Composition. 1968. Compt. Rend. Acad. Bulg. Sci., 21, 1041-1044

A method for determining microquantities of uranium in specimens with unknown chemical composition is described. The samples were crushed to a fine powder, mixed, and divided into two identical specimens. One of the specimens was mixed with a few drops of solution containing a soluble uranium salt of known concentration and the other was mixed with a few drops of pure solvent. Then the two solutions were compressed into two

<604> CONT.

tablets, which were irradiated in a neutron flux. The fission fragments from the specimens were recorded using a detector and the uranium content determined. The method is suitable for determining uranium concentrations in soil, carbon, wood, air, and water. (Auth)

<605>

Katsurayama, K., Accumulation of Radioactivity in Rice Fields. 1968, October. Annu. Rep. Res. Reactor Inst., Kyoto University, 1, 293-297 (Kyoto University, Kyoto, Japan)

The adsorption capacity of the following radioactive isotopes in the soil is discussed: Li, Na, K, Rb, Mg, Cs, Ca, Co, Ba, Sr, H, La, and Th. Equations are given for coefficients of distribution and exchange. Ion exchange capacity of the soil is discussed. Estimation of radioactive concentration in the root zone of rice fields is based on the following phenomena: introduction of water into the rice field; percolation in the superficial soil of the rice field; disintegration of radioactive elements; and accumulation of radioactivity in cultivable soil. A method for estimating the quantity of radioactivity carried by irrigation water into the rice field in the course of a year is described. (NSA)

<606>

Kauranen, P., T. Jaakkola, and J.K. Miettinen, Stable Lead and Radiolead Protactinium 210 in the Arctic Food Chain. 1969. NVO-3446-13 (University of Helsinki, Department of Radiochemistry, Helsinki, Finland)

In connection with studies of Pb 210 in the environment and human food chains in Finland, a number of analyses of stable lead were also carried out. Preliminary results on stable lead as well as Pb 210 in lichen are given. It is seen that in samples from Lapland the Pb 210 concentration may be slightly higher, while the stable lead concentration is significantly lower than in samples from southern Finland. As a consequence, the specific activity of lead in lichen from Lapland is very high, above 1000 pCi/mg. In southern Finland the specific activity seems to be around 300 pCi/mg. In reindeer samples specific lead activities between 700 and 1000 pCi/mg were found in most cases. The lower value found for reindeer meat is subject to analytical uncertainties because of the very low lead concentrations. Results for human samples indicate that the average stable lead concentration of blood is about the same in Lapps and in southern Finns, while the Pb 210 concentration in the Lapps is about 2.5 times higher. This is obviously a consequence of the higher specific activity of lead in the arctic food chain lichen-reindeer-man. The average specific activity of lead in human blood was found to be 47 pCi/mg in Lapps and 20 pCi/mg in southern Finns. It seems obvious that lichen is the source of the high specific activity lead in the arctic food chain, and that this lead gradually becomes diluted with less active lead from other sources. (NSA)

<607>

Kavteladze, B.M., and Yu.P. Osei, Assimilation and Distribution of Strontium 89 in Apple Trees. 1968, April. Soobshch. Akad. Nauk Gruz. SSR, 50(1), 185-190

The comparative uptake and distribution of Sr 89 through wood, sound bark, and soil by the

apple sapling of the Shampanskii renet variety were studied. In the first test, strontium nitrate solution with an activity of 100 uCi/15 ml was inoculated directly into the wood. In the second test Sr 89 in solution of the same activity was applied to the trunk of the tree at heights of 10 cm from the ground. In the third test Sr 89 with a total of 1100 uCi was introduced into the soil. The results showed that in all cases Sr 89 was assimilated by the plant. The distribution of the strontium had a damaging character. The concentration of Sr was higher in the lower part of the apple tree than in the upper part. The transfer of the strontium proceeded in a basipetal and radial direction. The rate of the Sr 89 transport after inoculation through the wood was approximately 10 cm/hr. At the end of the tests, the strontium had accumulated principally in the roots, then in the bark, and then the wood. The content of strontium in the seeds exceeded that in the apple pulp. (Auth)

<608>

Kavteladze, B.M., and Yu.P. Osei, The Absorption of Strontium 89 by Grape Vine Under Top Dressing. 1969, May. Akad. Nauk Gruz. SSR, 54, 829-832

The pathways of penetration of radiostrontium into the leaves as well as the effect of radioactive pH solution on the foliar absorption intensity by the grape vine were studied. It has been ascertained that mechanical injury of grape vine foliage favors the penetration of Sr 89 into the plant. Comparison of the cuticular and stomatal uptake of Sr 89 results in the conclusion that the assimilation of the latter occurs mainly through stomas. Having passed into the stem of the plant by means of the leaf vascular system, radiostrontium moves acropetally, lessening in distribution. The predominant concentration of strontium occurs in the plant leaves. Basipetal translocation of Sr 89 is greatly hampered or does not take place at all. In the present case, the higher the acidity of radioactive solution applied to the leaves the more readily it is assimilated and translocated throughout the plant. (Auth)

<609>

Kawai, H., and Y. Honda, Alpha Emitters in Foods. 1967. Kinki Daigaku Genshiryoku Kenkyusho Nenpo, 6, 15-19 (Kinki University, Osaka, Japan)

The alpha-ray activities were determined in foods by a radiochemical method. The successive ion exchange separation of uranium in foods is discussed. The following results were obtained: recovery of uranium by the method was 78.3 plus or minus 3.8 percent on the average; contamination of other nuclides was not found in a separated fraction and separation of uranium was performed almost perfectly; and the uranium content in some vegetation was determined. It was found that the uranium content of vegetables was somewhat greater than the content in cereals, green tea ("Ban-tya"), and potatoes. (NSA)

<610>

Kawase, K., Studies on Radioactive Fallout in Soils of Various Types. 1972. Proc. Jap. Conf. Radioisotop., 10, 562-567 (Niigata University, Niigata, Japan)

From the necessity of knowing the degree of contamination on the Earth's surface by fallout from past nuclear detonations for future discussion on environmental radioactivity due to nuclear power generation,

<610> CONT.

a number of studies on the distribution and moving mechanism of Sr 90 and Cs 137 in the various types of soils in Niigata Prefecture have been made. Soil samples taken from fifteen localities in 1965-1968 include paddy soil, field soil, forest soil, and lacoon soil, and the sampling depth ranges from 10 to 70 cm. The Sr 90 was measured by radioactive strontium analysis and the Cs 137 by gamma spectrometry. The concentration of the Sr 90 measured ($\mu\text{Ci}/\text{kg}$) ranged from 18 to 316 (mostly 100 to 200), and that of the Cs 137 ranged from 79 to 451 (mostly 200 to 400). Cs 137/Sr 90 ranges from 1.5 to 2.9. From these results, it was concluded that the effect of the contamination is great. The maximum values of the Sr 90 and Cs 137 cited above are the highest in Japan for the concentration of these nuclides caused by fallout. (NSA)

<611>

Kedrov-Zikhman, O.K., T.K. Bercova, V.K. Zhelnova, E.P. Bazedskii, L.I. Artem'eva, and N.S. Prokhorov, Effects of Radioactive Strontium on the Harvest of Agricultural Plants in Lime Soil. 1966. *Agrokhiimiya*, 1, 113-122

The addition of lime to acid peat-podzolic soils significantly decreases the uptake of radioactive Sr by 100 g quantities of barley, red clover, alfalfa, white mustard, flax, carrots, and beets, but with respect to all harvests, the radioactivity is decreased or increased as a function of the biological characteristics of the plants and the conditions in which they are cultivated. The principal fraction of the radiostrontium is absorbed by the vegetative tissues of the above-ground part, and a smaller fraction is accumulated in the reproductive organs. Strontium decay did not significantly affect the total harvest or individual plant organs. Stable strontium influences plant harvest positively. The radioisotopes of strontium are extracted by the plants less from black soils than from peat-podzolic soils. The importance of liming as an effective ameliorating factor and a modality in decreased absorption of radiostrontium by the plants was emphasized by the test. (tr-Auth)

<612>

Keefe, D.H., and M. Dauer, Natural Environmental Radioactivity in South Florida Sands and Soils, February-June 1968. 1970, September. Radiological Health Data and Reports, 11, 441-448 (U.S. Department of Health, Education, and Welfare, Washington, DC)

An investigation of the naturally occurring gamma-emitting radionuclides present in selected sands and soils of south Florida was conducted. Although the primary interest was in the natural environmental radioactivity from U 238, Ra 226, Th 232, and K 40 the concentrations of five fission products were also determined to minimize the error in computing the concentrations of the four naturally occurring radionuclides. The determination of these nine radionuclides in 45 environmental samples was performed by the linear least-squares method of analysis utilizing a computer. (Auth)

<613>

Keefe, R.F., and R. Estep, The Fate of Zinc 65 Applied to Two Soils as Zinc Sulfate and Zinc-EDTA. 1971. Soil Science, 112, 325 (West Virginia University, Morgantown, WV)

Labeled Zn 65 was added as ZnSO₄ and Zn-EDTA

to pots containing two soils adjusted to pH 7 with CaCO₃. Two successive 5-week corn crops were grown on these soils in the greenhouse. Corn roots were removed and the soil was thoroughly mixed before sampling. Soil Zn was fractionated into water-soluble, acid-soluble, organic-complexed, clay-exchangeable, clay-fixed, and sand plus silt residue. Most of the Zn added to both soils became acid-soluble and/or fixed on the clays. As time progressed, the amount of added Zn which was acid-soluble decreased in both soils with a concomitant increase in added Zn held on the soil organic matter. This was more apparent on the Wharton soil which was higher in organic matter and available Zn. With time, more added Zn was fixed on the clays where Zn-EDTA was applied than with ZnSO₄. This increase in Zn "fixed" on the clays with time from the added Zn-EDTA may help to explain poor response to Zn-EDTA application on certain soils since this form of Zn would probably be bonded to the clay fraction so strongly it would not be available for plant use. (Auth)

<614>

Keil, R.A., and B. Rajewsky, Determination of the Amount of Natural Radioactive Nuclides in Soil and Construction Materials by Means of Gamma-Ray Spectrometry. 1968. *Atompraxis*, 14, 421-426 (Max-Planck-Institut fuer Biophysik, Frankfurt am Main, German Federal Republic)

An energy-range method is described for determining the nuclide concentrations of Th 232, Ra 226, and K(nat) in soil and construction materials with the aid of a gamma-ray scintillation spectrometer. The setup was calibrated and gauged with solutions of Ra 226 chloride, Th 232 nitrate, and K(nat) chloride. With this method it is possible to determine concentrations of these nuclides with an accuracy of more than plus or minus 1%. The values measured with this setup for Th 232, Ra 226, Th 232, Ra 226, and K(nat) in characteristic soil and construction-material types are listed. (Auth)

<615>

Keller, L.L., Jr., Worldwide Correlation of Soil and Population. 1971. SR-RR-71-21; 65 p. (Sandia Laboratories, Albuquerque, NM)

The development of a data base containing the worldwide correlation of soil and population is discussed. A set of computer programs (SHA2, POPDEN, and INVABA) designed for use with the data base is described. These programs are designed to aid in the investigation of the hazard to people from earth-impacted radioisotope capsules. (Auth)

<616>

Kennedy, W.R., and W.D. Purtyman, Plutonium and Strontium in Soil Near Technical Area 21, Los Alamos Scientific Laboratory, Los Alamos, New Mexico. 1970. LA-4563; 5 p. (Los Alamos Scientific Laboratory, Los Alamos, NM)

A study was made of the content of Pu 238 and Pu 239 in soil around the location of Los Alamos Scientific Laboratory to determine amounts of plutonium deposited from laboratory ventilation stack emission. In general the plutonium concentrations decrease with increased distance from the stacks. Results were similar insofar as locations of maximum concentrations to those found in 1956. Calculations as to total amounts deposited within a radius of approximately one mile give approximately 2% of the total released from the stacks in the 24 year period of operation.

<616> CONT.

Strontium analyses were made to possibly distinguish fallout from atmospheric tests from stack emission material by use of the Pu 239/Sr 90 ratio method. The method proved invalid because of trace deposition of Sr 90 in the soil from past activities in the area. (NSA)

<617>

Kennedy, W.R., and W.D. Purtymun, Plutonium and Strontium in Soil in the Los Alamos, Espanola, and Santa Fe, New Mexico Areas. 1970, November. LA-4562: 4 p. (Los Alamos Scientific Laboratory, Los Alamos, NM)

Analyses for plutonium isotopes Pu 238 and Pu 239 and strontium isotope Sr 90 were made of soil samples collected from the Los Alamos, Espanola, and Santa Fe areas to determine concentration levels considered as originating from worldwide fallout from atmospheric tests. On the basis of the limited number of samples it was concluded that the concentrations in soils from the area of study were similar to but no greater than those reported by others for soil samples from Colorado, Ohio, and New York. (Auth)

<618>

Kerpen, W., and H.W. Scharpenseel, Movement of Ions and Colloids in Undisturbed Soil and Parent Rock Material Columns. 1967. CONF-670641; STI/PUB-158; Part of Proceedings of a Symposium on the Use of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies held in Istanbul, Turkey, June 12-16, 1967, (p. 213-226 (Institut fuer Landwirtschaft der Kernforschungsanlage Jülich, German Federal Republic)

Undisturbed columns of different soils (Great Soil Groups) are subjected to percolation with repeated definite volumes of water, and the eluted rates of cations and anions are determined. The transportation of C 14-labeled humic acid, Fe 55(+3) and Fe 55-labeled montmorillonite, applied to the surface of the profile column, is checked by liquid-scintillation techniques. The results show the characteristic solubility rates and sequences of the different tested ions as well as the fractions in the individual soil types. This allows the balances of annual losses to be correlated with precipitation levels. After termination of the experiments (three to four years), the soil columns are transformed into thin-section layers which, by stripping emulsion autoradiography, reveal the localization of the labeled substances within the dispersal system of the soil skeleton and plasma. To study the sequential order and quantitative relation of ion liberation in different parent rock materials, 0.5-5-µ grain size particles are continuously percolated with distilled water in columns at 60 degrees Centigrade. The recycling system allows the dissolved and collected eluted material (ions and colloids) to be analyzed at constant intervals of 1 to 2 months. Diagenetic concretions from duripan, fragipan, pseudogley, laterite, podsol and caliche are continuously leached in Soxhlet extractors and the dissolved substances analyzed. (Auth)

<619>

Revera, N.R., Strontium and Calcium Uptake by the Green Alga, OOCYSTIS EREMOSPHAERIA. 1964. Science, 145, 1445-1446 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

The uptake of calcium and strontium by a green unicellular alga cultured in media containing these elements in concentrations found in nature is directly proportional to the concentration in the media. Variation in the concentration of either element has a slight inverse influence on the uptake of the other. The increase of strontium uptake when the calcium concentration is very low indicates that strontium is substituted for calcium when calcium is limited and suggests that the alga requires either element. (Auth)

<620>

Khalturin, G.V., and Ye.P. Sevast'yanova, Standard Plutonium Nitrate and Citrate Solutions for Biological Experiments. 1972. AEC-tr-7457; (P. 303-308) (Not given)

A technique is recommended for preparation of standard nitrate solutions of polymeric Pu (+4) with a pH of 1.0-2.0 and Pu (+5) and for preparation of standard nitrate solutions of Pu (+6). It was shown that Pu (+6) is stable for 3 months in solutions containing 2-12 M/liter nitric acid. Pu (+6) is unstable in solutions with a pH of 2.0. A method has been proposed for preparation of standard citrate solutions of polymeric Pu (+4), Pu (+4) (sic), and Pu (+6). It was shown that Pu (+5) is very unstable in citrate medium. (Auth)

<621>

Khasavneh, F.E., and S.A. Barber, Investigations of Calcium-Strontium Adsorption Selectivity in Clays and Soils. 1966. CONF-660820-1; COO-1495-1; 9 p. (Purdue Research Foundation, Lafayette, IN)

Exchangeable Ca and exchangeable Sr were measured on 64 soils from Indiana. The results showed a wider range in selectivity of the Ca-Sr exchange reaction in untreated soils than previously reported (0.36-2.11). The range was narrowed down considerably by eliminating the effect of other exchangeable ions and of different levels of soluble salts. There was a negative correlation between the selectivity coefficient and organic matter content and between the selectivity coefficient and CEC. Soil organic matter possessed a preference for Ca over Sr. Destroying the soil organic matter by H2O2 treatment resulted in a pronounced increase in Sr selectivity. Selectivity of a muck soil also indicated a preference for Ca. (ST)

<622>

Khasavneh, F.E., A.S.R. Juo, and S.A. Barber, Soil Properties Influencing Differential Calcium to Strontium Adsorption. 1968. Soil Science Society of America Proceedings, 32, 209-211 (Purdue University, Agriculture Experiment Station, Lafayette, IN)

The selectivity coefficient, the ratio of Sr to Ca as exchangeable cations divided by the ratio of Sr to Ca in solution, was found to vary from 0.61 to 1.51 on 63 Indiana soils. Soil factors influencing the variation in K values were studied on selected soils where K was determined after equilibration of the soil with an 0.1N chloride solution of Ca and Sr having a Ca/Sr molar ratio of approximately 190:1. Organic matter was negatively correlated with the K value (r=0.83). Removal of the organic matter with H2O2 on nine soils increased the K value. The magnitude of the increase was correlated with the percent organic matter in the soil (r=0.89). The organic fraction of the soil adsorbed Ca preferentially to Sr. The

<622> CONT.

inorganic fraction in most instances adsorbed Sr preferentially. (Auth)

<623>

Kichibekov, B.S., Strontium 90 Concentration in Food Products of Populations of Various Soil and Climatic Regions of Azerbaijan SSR During 1966-1969. 1972. Uch. Zap. Azerb. Med. Inst., 36, 40-41 (Not given)

The concentration of Sr 90 in food products in 1966 and in 1967-1969 from different climatic and soil regions of Azerbaijan (USSR) was determined. High Sr 90 content was noted in beef and sheep long bones; lesser concentrations were present in meat. Content in sheep was one to four times greater than in cows. The Sr 90 content of fish bones was ten times less than in land animals. Content in meat and milk was less in winter than in summer. Maximum Sr 90 content was noted in green tea and tobacco. The Sr 90 contents in food products in 1968-1969 were four to ten times lower than in 1963. (ST)

<624>

Kiel, R., P. Randow, H.A. Schulze, and I. Fleischer, Radioactively Contaminated Lichens and Their Special Radiohygienic Significance. 1970. Z. Gesam. Hyg. Ihre Grenzgeb., 16, 898-902 (University of Rostock, Rostock, German Democratic Republic)

On the basis of literature data the contamination of plants of the polar zone, especially of lichens, by fallout radionuclides and their inclusion in the terminal nutritional chain of man (Laplanders and Eskimos) is discussed. As has been revealed by some studies on some lichen species on different sites in the region of the Baltic Sea coast, there was a Sr 90 contamination ranging from 0.01 to 0.103 nCi/q ash or 1.1 to 2.4 nCi/kg (dry weight) and Cs 137 contents ranging from 0.08 to 0.91 nCi/q ash or 8.1 to 38.1 nCi/kg. These results are compared with findings from Lapland and Alaska. (Auth)

<625>

Kilibarda, M., D. Petrovic, D. Panov, and D. Djuric, Contamination with Polonium 210, Uranium, and Radium 226 Due to Smoking. 1968. CONF-660920-2: Part of Snyder, W.S., et.al. (Eds.), Proceedings of the 1st IBPA Congress on Radiation Protection held in Rome, Italy. Pergamon Press inc., New York, New York, Part 2, (p. 1099-1103) (Institute of Occupational Health and Radiological Protection, Belgrade, Yugoslavia)

The content of Po 210, Ra 226, and uranium has been examined in well-known Yugoslavian cigarettes and in tobaccos from regions of Yugoslavia where the best tobacco is produced. Simultaneous measurements were made of the content of these nuclides in the urine of smokers and non-smokers. The distribution of Po 210 in smoke, ash, and cigarette stubs as a function of combustion temperature was studied. Values of Po 210 in cigarettes ranged from 0.4 to 0.6 pCi/q, Ra 226 below 10(E-12) Ci/q and uranium was less than 5 gamma/q of cigarette. Analysis of the distribution of Po 210 has shown that about 40 percent is found in smoke. The urinary Po 210 values in smokers and non-smokers are different, but there is no significant statistical difference between them. (Auth)

<626>

King, L.G., Mathematical Model for Underground Discharge of Radioactive Gases. 1967. BNWL-SA-1152; 21 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Mathematical models were developed for injection of gas into the partially saturated zone above the water table. For the present capability of solving differential equations, one model is used during injection and a different model is used after cessation of injection. Assumptions made for the model were: the gas obeys Darcy's equation, soil moisture immobile, flow is isothermal and steady, soil is homogeneous and isotropic, soil moisture content is uniform, equation of state of dry air is sufficient to describe the gas, the gas is compressible, and the system is symmetric about the axis of the injection well. Comparisons of calculated and measured values were satisfactory. (NSA)

<627>

Kinniburgh, D.G., M.L. Jackson, and J.K. Syers, Selective Sorption of Trace Amounts of Calcium and Strontium by Hydrous Oxides of Iron and Aluminum. 1973. COO-1515-38; 34 p. (University of Wisconsin, Madison, WI)

Heated gibbsite, and freshly prepared Fe and Al gels selectively sorbed traces of Ca and Sr from solutions containing a large excess of NaNO₃. The fraction of the total Ca(Sr) sorbed depended principally on the suspension pH, the amount of solid present, and only to a lesser extent on the NaNO₃ and Ca concentrations. Significant Ca and Sr sorption occurred on the heated gibbsite, Fe and Al gels, at pH's below their points of zero charge (8.25, 8.05 and 9.40, respectively), indicating specific adsorption. For the heated gibbsite and Fe gel, an empirical model based on the law of mass action fitted the data reasonably well and suggested that for each Ca(+2) or Sr(+2) sorbed, about one H(+) was released, thereby leading to an increase in the net positive charge of the surface. Failure of the Al gel to fit the model is probably due to its rapid aging which leads to hysteresis in the sorption-pH curve. (Auth)

<628>

Kirchmann, R., Influence of Application of Stable Strontium to the Soil on the Strontium 90 Contamination of Cultivated Plants: Rye Grass and Clover. 1965. Physiologia Plantarum, 18, 885-890 (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium)

Field experiments were carried out in 1960, 1961, and 1962 on the effect of adding stable Sr to soil on the Sr 90 content of various parts of *LOLIUM ITALICUM* and *TRIFOLIUM PRATENSE*. A low-Ca soil was used, and stable Sr was added at levels of 3 or 7.5 g/m². The Sr 90 and Ca concentrations of the roots and foliage was measured in each of the three years. Statistical analysis of results showed that the treatments had no significant effect, at the p = 0.05 level, on the Sr 90 content of the foliage or the roots. However, the differences in Sr 90 content of the two species were significant at the p = 0.01 level; the content of rye grass was lower than that of clover. It was also observed that the addition of stable Sr to soil modified strongly the Sr 90/Sr ratio in the plant. It is concluded that application of stable Sr to soil is not of practical value in attempting to reduce the animal and human ingestion of radiostrontium originating from fallout. (NSA)

<629>

Kirchmann, R., R. Boulenger, and A. Lafontaine. Absorption of Radium 226 in Cultivated Plants. 1968. CONF-660920-2: Part of Snyder, W.S., et al. (Eds.), Proceedings of the 1st IRPA Congress on Radiation Protection held in Rome, Italy. Pergamon Press Inc., New York, New York, Part 2, (p. 1045-1051) (CEN, Mol, Belgium)

The absorption of Radium 226 by several cultivated plants (barley, beet, cabbage, carrot, potato, Ray grass, and violet clover) was examined by studies in test fields and greenhouses. Gamma spectrometry was used for the measurement of the Radium 226 content in various samples. During greenhouse studies, the effect of Ca deposition in the hydroxide and chloride forms on the Radium 226 absorption was studied. Comparisons of the absorption of Radium 226 by Ray grass were made for five different soils and two contamination levels; the results showed that there is an inverse correlation between the Radium 226 of the plant and the quantity of sorptive material of the soil. The results of field studies over three years, in a sandy soil whose upper layer had previously been contaminated to different levels with Radium 226, were reported. These results show that there are differences between the absorption of Radium 226 among the vegetable species studied; the distribution of Radium 226 in the plants is not uniform. In general the O.R. values ((Radium 226/Ca) plant/(Radium 226/Ca) soil = O.R.) show the presence of a very strong discrimination against Radium 226 in the transfer between the soil and the plant. (tr-Auth)

<630>

Kirchmann, R., J. Colard, and E. Faquart, Fixation and Physiological Action of Cobalt 60 in Some Cultivated Plant Species. 1970. CONF-690918-(Vol. 2); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 667-688)

A report is given of hothouse experiments aimed at determining the cobalt toxicity threshold and the symptoms of intoxication and the order of their appearance in PISUM SATIVUM grown in solutions and on different types of soil containing variable amounts of cobalt are described. The influence on the root system (inhibition of the growth of the main root and nonformation of secondary roots) and on the development of the aerial part is demonstrated. Hydroponic experiments on the fixation and transport of Co 60 in PISUM SATIVUM at various stages of development are also described and the results discussed. Observations on the behavior of young purple clover, carrot and beetroot plants cultivated on soil containing up to 240 ppm of Co (+2) are reported. The fixation of radio-cobalt and its distribution in various organs of plant species (ryegrass, clover, turnip, barley) were studied under conditions simulating a temporary flood on the one hand, and from uniformly contaminated soil and drainage mud on the other. (Auth)

<631>

Kirchmann, R., and T.J. D'Souza, Behavior of Ruthenium in an Established Pasture Soil and Its Uptake by Grasses. 1971. CONF-711213; IAEA/SM-151/5: Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971 (Centre d'Etude de l'Energie Nucleaire, Department of Radioecology, Mol,

Belgium)

Data representative of "field loss" of radioruthenium from grass pasture was presented. After direct deposition of a soluble form of ruthenium 106 the "field loss-T 1/2 (w.t.)" was approximately 8 days. Ruthenium 106 rapidly moved through the soil profile. Some ruthenium appeared to become unavailable to plants by "fixing" on the organic and fine mineral fractions of soil. (CWF)

<632>

Kirchmann, R., G. Koch, V. Adam, and J. van den Hoek, Studies on the Food Chain Contamination by Tritium. 1971. CONF-710809: Part of Moghissi, A.A. and Carter, M.W. (Eds.), Proceedings of a Symposium on Tritium held in Las Vegas, Nevada, August 30-September 2, 1972, (p. 341-348), 807 p. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium; Laboratorium voor Fysiologie der Dieren, Wageningen, Netherlands)

Tritium differs from other radionuclides in that it becomes rapidly distributed in a particular environment when released as tritiated water; at the same time, it is diluted to a considerable extent with light water. This need not be true to the same degree for tritium incorporated in organic material. Thus, the chemical form in which tritium is taken up is an important consideration. (Auth)

<633>

Kirchmann, R., J. van den Hoek, and J. Colard, Evolution of Strontium and Cesium Contamination in Grass and Milk in Relation to the Moment of Deposition of the Radionuclides on Pasture. 1969, May. CONF-690527; Part of Proceedings of the Fifth Radioactivity in Scandinavia Symposium held in Helsinki, Finland, May 1920, 1969

Seasonal factors affecting the transport of Cs 134 and Sr 85 through pasture grass-milk-man food chains were investigated. It was concluded that direct foliar retention was the mechanism responsible for the uptake of Cs 134 and Sr 85 by cattle and highest values were observed during spring and early summer months. (NSA)

<634>

Klechkovskii, V.M. (Ed.), G.G. Polikarpov (Ed.), and R.M. Aleksakhin (Ed.), Radioecology. 1973. John Wiley and Sons, Inc., New York, New York, 381 p. (Not given)

A general review of USSR radioecological work is presented in 17 chapters. Major emphasis is placed on movement of radionuclides in soils and forested ecosystems. Two very good chapters are about the behavior of natural radionuclide in soil and the radioecology of landscapes in the far north. (CWF)

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Klechkovskii, V.M., Ye.A. Fedorov, N.P. Arkhipov, G.M. Romanov, R.M. Aleksakhin, L.T. Febraleva, and K.E. Timiryazev, Patterns of Supply of Radioactive Strontium to Crops Through the Soil and Air. 1973. Soviet Soil Science, 3, 338-346 (Timiryazev Academy of Agriculture, Moscow, Russia)

The main patterns of supply of Sr 89 to crops are examined. The possibility of forecasting the amount of Sr 89 taken up from soil and accumulated in the plant harvest by calculating the effect of exchangeable Ca (+2)

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was experimentally confirmed. The existence of two Sr 89 fractions, differing in their stability of fixation by plants, was confirmed for the aerial supply. (Auth)

<636>

Klechkovskii, V.M., and I.V. Gulyakin, Behavior of Tracer Amounts of Strontium, Cesium, Ruthenium and Zirconium in Soils and Plants According to the Data of Investigations with Radioactive Isotopes of these Elements. 1958. Part of Extermann, R.C. (Ed.), Proceedings of an International Conference on Radioisotopes in Scientific Research held in Paris, France, 1957. Pergamon Press, New York, (p. 150-171) (USSR Ministry of Agriculture, Moscow, USSR)

Absorption and desorption of microquantities of cesium, strontium, ruthenium and zirconium in soils, their accumulation and distribution in plants were studied in experiments with the use of radioactive isotopes of these elements. The uptake of cesium and strontium by plants from the aqueous solutions is relatively more intensive as compared with that of ruthenium and zirconium, the accumulation of the latter being considerably lower. Moreover ruthenium and zirconium are mainly held up in the root system of the plant, while strontium and cesium penetrate mostly into the aboveground parts of the plant, accumulating in leaves and stems and, to a lesser degree, in the reproductive organs. The influence of the salt content of the solution and its reaction on the penetration of microquantities of the above mentioned elements into the plants was studied. In experiments with foliar application of microquantities of the said elements, cesium showed the most marked capacity for passing from the treated leaves to other parts of the plant and for being accumulated in its reproductive organs. The movement of the radioactive isotopes of cesium, strontium, ruthenium and zirconium from the soil into the plant is greatly influenced by the absorption and desorption processes of these elements in the soil. The laws governing the interaction of various types of soils with solutions containing microquantities of cesium, strontium and zirconium were studied. The effect of fertilizers, liming and other factors on the assimilation of these elements by the plants from the soil, was also investigated. It was established that the ion-exchange nature of strontium absorption in soil and its capacity for desorption is responsible for relatively more intense uptake by plant of radioactive strontium from the soil. Microquantities of cesium are, as a rule, fixed more strongly in soils, partly in non-exchangeable form, which accounts for considerably reduced cesium uptake from the soil. In the soil absorption and desorption processes of radioactive substances in soil represented by two genetically bound radioactive nuclides such as strontium 90 and yttrium 90, or zirconium 95 and niobium 95 the equilibrium between mother and daughter isotopes is disturbed. The change in the ratio between mother and daughter nuclides is also observed in the process of assimilation of Sr 90 + Y 90 by plants and particularly in their movement from one part of the plant to another. It has been shown that if strontium 90 is applied through the leaves, yttrium 90 formed in the tissue of the leaf moves into the young and growing parts of the plant more rapidly than strontium. A similar phenomenon is observed in experiments with grafted plants when microquantities of radiostrontium were administered through the roots of one of the components of the grafted plant (before grafting) and when subsequent

movement of Sr 90 + Y 90 was studied under such conditions. (Auth)

<637>

Klechkovskii, V.M., and I.V. Gulyakin, The Behavior in Soils and Plants of Traces of Strontium, Cesium, Ruthenium, and Zirconium. 1958. Soviet Soil Science, 3, 219-230 (K. A. Timiryazev Agricultural Academy, USSR)

Progress on sorption and desorption by soil and plant uptake and distribution of various radionuclides is reported. (CWF)

<638>

Klechkovskii, V.M., L.N. Sokolova, and G.N. Tselishcheva, The Sorption of Microquantities of Strontium and Cesium in Soils. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 486-493), 624p.

Experiments of adsorption and desorption of radioactive strontium and cesium to soils indicated calcium could be considered a "nonisotopic carrier" of radioactive strontium. Soil chemistry reactions of cesium are analogous to that of potassium; however, in microquantities the cesium is held more tenaciously than potassium. (CWF)

<639>

Klechkovskii, V.M., (Ed.), On the Behavior of Radioactive Fission Products in Soil, Their Absorption by Plants and Their Accumulation in Crops. 1957. AEC-tr-2867; Translated from Academy of Sciences of the USSR

This is an English translation from Russian of some of the earlier USSR experiments involving the behavior of radionuclides in soils and agricultural crops. (CWF)

<640>

Kleese, R.A., Relative Importance of Stem and Root in Determining Genotypic Differences in Strontium 89 and Calcium 45 Accumulation in Soybeans (GLYCINE MAX L.). 1967. Crop Science, 7, 53-55 (University of Minnesota, Department of Agronomy and Plant Genetics, St. Paul, MN)

Stem grafts were made among 8 to 10 day-old soybean plants to ascertain the role of stem and root in determining varietal differences in accumulation of Sr 89 and Ca 45 in seed and in the terminal portion of the stem. The effect of the graft per se was negligible as evidenced by similar Sr 89 and Ca 45 accumulation in grafted plants with stem and root of identical genotype and the ungrafted plants of the same genotype. Accumulation of Sr 89 and Ca 45 in seeds was largely controlled by the genotype of the stem. In the terminal 12 to 15 cm of the stem Sr 89 and Ca 45 accumulation was controlled by both stem and root, with the stem being relatively more important. (Auth)

<641>

Kline, J.R., Retention of Fallout Radionuclides by Tropical Forest Vegetation. TID-24270; part of Odum, H.T. and Figeon, R.F. (Eds.), A Tropical Rain Forest, (p. H. 191-197) (Puerto Rico Nuclear Center, Rio Piedras, Puerto Rico)

Freshly fallen leaf litter and live-leaf samples pruned from trees were collected monthly at the El Verde experimental site for

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measurement by scintillation spectrometry of gamma emitting radionuclides of stratospheric origin. Input of radionuclides during the period of the collections was below the detection limits of the measuring technique. The objective of the collections was to measure the biological half-times for retention of four nuclides in tropical forest vegetation. The nuclides measured were Zr 95-Nb 95, Ce 144, Cs 137, and Mn 54. The average effective half-times for Zr 95-Nb 95, Ce 144, Cs 137, and Mn 54 were 120, 228, 450, and 250 days, respectively. The environmental half-times computed from these data were doubling time of 141 days for Zr 95-Nb 95, 1140 days for Ce 144, 469 days for Cs 137, and 1230 days for Mn 54. The doubling time for Zr 95-Nb 95 indicates a continuing input of this nuclide into the El Verde forest. Because Cs 137 has the longest physical half-life, its environmental half-life can be most precisely determined; the estimates for the other nuclides are less reliable. The data show that some of the nuclides were partially incorporated into the forest mineral cycle. The nuclide least involved in cycling was Cs 137. (Auth)

<642>

Kline, J.R., J.A. Colon, and S.S. Brar. Distribution of Cesium 137 in Soils and Vegetation on the Island of Puerto Rico. 1973. Health Physics, 24, 469-475 (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, IL)

Soils and vegetation of Puerto Rico were collected along five north-south transects of the island and analyzed for Cs 137 content. The results showed an apparent gradient of this nuclide with high amounts in the eastern samples and low amounts in the western samples. Activity in samples was strongly related to rainfall patterns on the island; however, high mountain forests were much more highly contaminated than could be accounted for on the basis of rainfall deposition alone. This was attributed to the properties of vegetation itself, rather than alteration of deposition patterns. The vegetation is suggested to have high aerosol interception efficiency and low turnover rates, which could combine to produce the observed concentrations. The data were used to test and reject the hypothesis that observed Cs 137 distribution on the island was due to changes in atmospheric aerosol scavenging efficiency. Data from soil samples suggest that the island has intercepted a minimum of 535 Ci of Cs 137 from past nuclear weapons tests. (Auth)

<643>

Kline, J.R., and C.F. Jordan. Tritium Movement in Soil of a Tropical Rain Forest. TID-24270; Part of Odum, H.T. and Pigeon, R.F. (Eds.), A Tropical Rain Forest, (p. H. 129-131) (Puerto Rico Nuclear Center, San Juan, Puerto Rico)

Tritiated water applied to the surface of soil in a tropical rain forest was found in free water of the litter and the top 18 cm of soil as long as 7 months after its application. It was concluded, therefore, that plant roots, even in the high-rainfall environment of a tropical rain forest, are exposed to tritiated water for a considerable time after release. (Auth)

<644>

Kline, J.R., J.R. Martin, C.F. Jordan, and J.J. Koranda. Measurement of Transpiration in Tropical

Trees with Tritiated Water. 1970. Ecology, 51, 1068-1073 (Argonne National Laboratory, Argonne, IL; University of California, Lawrence Radiation Laboratory, Livermore, CA)

The measurement of transpiration of water by trees in the field with tritiated water as a tracer depends upon a new application of established theory of radionuclide dynamics in steady-state systems. The techniques required are non-destructive to the trees and probably have negligible disturbing effect on transpiration. Average transpiration rates ranging from 1.75 to 372 liters per day per tree were measured by the proposed method on tropical forest trees which ranged from the understory to the canopy in size. Statistical errors range from 12.1% on the largest tree to 6.2% on the smallest for one standard deviation. Non-random sources of error in the method may include loss of tritium from leaves due to rainfall; and possible enrichment of tritiated water in leaves due to differences in vapor pressure and molecular diffusion coefficients between tritiated water and ordinary water. These require further experimental evaluation. The method may be generally applicable to field measurements of transpiration in trees. (Auth)

<645>

Kline, J.R., and M. Mercado. Preliminary Studies of Radionuclide Cycling in Understory Plants in the Rain Forest. TID-24270; Part of Odum, H.T. and Pigeon, R.F. (Eds.), A Tropical Rain Forest, (p. H. 205-209) (Puerto Rico Nuclear Center, Rio Piedras, Puerto Rico)

An experiment was carried out in the understory of the El Verde rain forest to determine the fate of several radionuclides applied to the forest floor in water-soluble carrier-free form. To each of four plots Cs 134, Sr 85, and Mn 54 were applied at rates of about a mCi/m². Small leaf samples from the plants on each plot were collected periodically for one year; the experiment was then terminated by completely harvesting all plant material. Uptake by plants was extremely slow for all the nuclides of this experiment. The harvested plant material showed that in one year less than 1 percent of the Cs 134 and Mn 54 was taken up by the plants. Soil samples showed that in excess of 90 percent of the Cs 134 remained in the surface 3-in layer after 18 months and that from 2 to 9 percent was in the organic surface litter. It was concluded from the slow movement of nuclides that the El Verde forest was not in a steady state with regard to turnover of its burden of fission products. The experiment supports the hypothesis that fission products in vegetation of this forest are the result of their interception and retention on leaf surfaces. (Auth)

<646>

Kline, J.R., and H.T. Odum. Comparisons of the Amounts of Fallout Radionuclides in Tropical Forests. TID-24270; Part of Odum, H.T. and Pigeon, R.F. (Eds.), A Tropical Rain Forest, (p. H. 181-186) (Puerto Rico Nuclear Center, Rio Piedras, Puerto Rico)

Leaves and forest litter were collected from 10 tropical forests in Puerto Rico, Dominica, Trinidad, and Central America for analyses of fallout radionuclide content. Measurements were made by gamma scintillation spectrometry for Ce 144, Cs 137, and Mn 54. Highest levels of these isotopes were found in the northernmost tropical forests at the highest elevations above sea level. The amounts of

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contamination showed a general decrease with decreasing latitude. Forests at the same latitude were contaminated in relation to the mean annual rainfall at the sampling site. Individual species within a given forest showed wide variations in the levels of contamination, but, in general, plants with an epiphytic growth habit were more heavily contaminated than the surrounding tree species. Comparisons of leaves and forest litters indicated an apparent accumulation of Ce 144 and Mn 54, but not of Cs 137, in the litter of all forests examined. All forests except one showed detectable but low-level amounts of Zr 95-Mb 95 in both leaves and litters. The one exception, a forest in Mexico showed an average of 3.5 picocuries/g in the leaves and 10.3 picocuries/g in the forest litter. Levels of Ce 144, Cs 137, and Mn 54 were not correspondingly high in this forest. Fresh fission products, such as I 131, Ba 140, La 140, and Ru 103, were not found. (Auth)

<647>

Klobe, W.D., and R.G. Gast, Reactions Affecting Cation Exchange Kinetics in Vermiculite. 1967. Soil Science Society of America Proceedings, 31, 744-749 (University of Tennessee, Agriculture Research Laboratory, Oak Ridge, TN)

Strong retention of cations, commonly referred to as fixation, was studied using Cs and Sr exchange reactions with Montana Vermiculite. Fixation was defined as the property of an exchanger to retain cations in a state such that they are not available for rapid isotopic exchange in a well-stirred system. Efforts were directed toward qualitatively determining some of the conditions under which fixation occurs. Equations were derived to calculate fixation using isotopic equilibrium values attained with separate aliquots of carrier-free isotope. Cesium fixation occurred in all size fractions of vermiculite ranging from 40-20 mesh through <0.2 μ upon addition of 1 symmetry stable CsCl. The amount of Cs 134 fixed at this Cs level depended on the sequence of adding separate aliquots of isotope and the corresponding stable salt, and appeared to be caused by lattice collapse. The amount of Cs fixed increased with increasing additions of CsCl. However, when Cs saturation of the vermiculite exchange capacity exceeded 4.5 percent, the fraction of sorbed Cs that became fixed was relatively constant. A plot of Cs fixation vs percent Cs saturation of the exchange capacity indicated that fixation was independent of time over an interval of 4 months. In contrast to the Cs results, Sr was always readily exchangeable, with no evidence of lattice collapse. (Auth)

<648>

Klobe, W.D., and R.G. Gast, Conditions Affecting Cesium Fixation and Sodium Entrapment in Hydrobiotite and Vermiculite. 1970. Soil Science Society of America Proceedings, 34, 746-750 (University of Tennessee, Agricultural Research Laboratory, Oak Ridge, TN)

The effect of residual and added K on Cs fixation was studied, using samples of K-extracted Transvaal, South African hydrobiotite with 66, 60, 23, and less than one percent K saturations. Fixation was measured by the availability of the cations for rapid isotopic exchange in a well-stirred system. Over 95 percent of the sorbed Cs was fixed above one percent Cs saturation of the exchange capacity regardless of K levels or

whether the K was in the form of residual K in hydrobiotite or K added to the vermiculite prior to addition of the Cs. In contrast, trace levels of Cs (i.e., carrier-free Cs 137) were fixed to a much lesser extent, indicating that it may be more available for plant uptake. X-ray and Na entrapment results indicate that Cs saturations below 40 percent of the exchange capacity result largely in interstratified Na- and Cs-rich layers with little edge collapse. Higher Cs saturations resulted in increased edge collapse and Na entrapment. Formation of interstratified layers vs. edge collapse of the particles tends to be associated with smaller and larger particles, respectively. (Auth)

<649>

Knaelmann, M., Effect of Concentration Supplied on the Iodide Sorption by Various Soils. 1970. Atomkernenergie, 16, 247-252 (Technische Hochschule, Hannover, German Federal Republic)

Among all fission products, I 131 is relatively easily transported in the soil. Therefore, its uncontrolled spreading in the soil constitutes a hazard. The sorption of I by 59 different soils was investigated. Iodine was supplied in form of aqueous iodide solutions of different concentrations. Differences in the relative sorption were noted among the various soils, however, the plot of concentration supplied versus relative sorption gave similar shaped curves for all soils. (Auth)

<650>

Knauss, H.J., and J.W. Porter, The Absorption of Inorganic Ions by CHLORELLA PYRENOIDOSA. 1954. Plant Physiology, 29, 229-234 (General Electric Company, Radiological Sciences Department, Biology Section, Richland, WA)

The isotope method was used to determine the quantities of an element present in CHLORELLA when the nutrient concentration of that element was varied. Elements used in these studies were P, Ca, S, Fe, Mn, Zn, Cu, and Sr. The absorption, by the algae, of all elements except P and S was directly proportional to the concentration of that element in the nutrient solution. The quantities of P and S in the algal cells were constant when the cells were grown in the higher nutrient concentrations of these elements. A brief discussion is presented of the sources of error existent in the isotope method of determining the elemental content of algae and the effect of the nutrient concentration of an element on its absorption by algae. (Auth)

<651>

Knoll, K.C., Reactions of Organic Wastes and Soils. 1969. BNWL-860; 15 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

The passage of certain organic wastes from a radionuclide separations plants has little effect on the permeability of the soil for later passage of a high salt aqueous waste, or on the ion exchange properties of the soil. Soil removed Pu 239 and Am 241 slowly from some of the organics and not at all from others. Radionuclides were leached from soils most noticeably by two of the wastes. One was a mixture of 0.4M bis(2-ethylhexyl)ester of phosphoric acid and 0.2M tributyl phosphate in paraffin hydrocarbons (C10 to C14); the other was hydroxyacetic acid. Both of these removed Sr 85 and Am 241 and to a lesser extent Pu 239. (Auth)

<652>

Kodaira, K., A. Tsumura, and E. Kokayashi, Uptake of Radioactive Strontium and Cesium in Rice Plants. I. Accumulation of Strontium and Cesium in Rice Grains Through Roots. 1973. J. Radiat. Res., 14, 31-39 (National Institute of Agricultural Sciences, Tokyo, Japan)

Water-cultured rice plants were exposed to Sr 89 or Cs 137 through roots for five days at their various growth stages and continued to grow until harvest. The harvested grains were radiochemically analyzed and the concentration factors were calculated. The maximum uptake of Cs 137 in the grains was found at the booting stage, while that of Sr 89 was at the flowering stage. The Cs uptake was 400 times higher at the booting stage, and 30 times at the flowering stage than those with Sr. The growth stage dependency of the uptake of Sr and Cs was the most important factor for a selective enrichment of Cs in rice grains. The specific affinity of Cs to cell sap and that of Sr for membrane substances of rice grains probably caused a selective redistribution inside the plant body. (Auth)

<653>

Kokotkov, A.Ya., and E.I. Belova, Natural Leaching of Strontium 90 From Soils. 1972. Gig. Sanit., 5, 111-113 (Not given)

The Sr 90 distribution profiles were observed for a number of years in turf-podzol and in black earth soils in experimental plots which were contaminated with Sr 90 in a controlled manner. The data indicate that a significant difference exists in the retention of Sr 90 by the two soils: the period of half-removal from the black earth soil under natural conditions was greater than that period characterizing the turf-podzol soil. (NSA)

<654>

Kokotkov, Yu.A., and R.F. Popova, Sorption of Long-Lived Fission Products by Soils and Argillaceous Minerals. III. Selectivity of Soils and Clays Toward Strontium 90 Under Various Conditions. 1962. Soviet Radiochemistry, 4, 292-297

The discrepancies between the distribution coefficient of strontium 90 and the exchange capacity of the soil according to Nikolskiis equation are explained. The differences in the strontium 90 distribution coefficients curves on changing soil pH are expressed in terms of the macrocomponent on the said exchange. (CWF)

<655>

Kokotkov, Yu.A., R.F. Popova, I. Tsing-Chih, and M. Shih-tsi, Sorption of Long-Lived Fission Products by Soils and Argillaceous Minerals. II. Sorption of Cerium 144 by Soils. 1962. Radiokhimiya, 4, 227-228

Mechanisms governing the adsorption of Cerium 144 to soils were investigated. In alkaline solutions the adsorption of cerium to soil is much lower than in more acid solutions (pH < 2). (CWF)

<656>

Kokotkov, Yu.A., R.F. Popova, and A.P. Urbanyuk, Sorption of Long-Lived Fission Products on Soils and Clay Minerals. 1961. Soviet Radiochemistry, 3, 213-221

The effect of pH and counter cations on the distribution coefficients of strontium 90 was

evaluated for a number of Russian soil types. They found that strontium 90 could only be leached from soils of low cation exchange capacity by salt concentrations greater than 0.01 N. cesium 137 appeared to be fixed in microamounts to many of the soils. (CWF)

<657>

Kolehmainen, S., E. Haesaenen, and J.K. Miettinen, Cesium 137 in the Plants, Plankton, and Fish of the Finnish Lakes and Factors Affecting its Accumulation. 1968. CONF-660920-1; Part of Snyder, W.S., et.al. (Eds.), Proceedings of the 1st IRPA Congress on Radiation Protection held in Rome, Italy. Pergamon Press Inc., New York, New York, Part 1, (p. 407-415) (University of Helsinki, Helsinki, Finland)

Bioaccumulation of Cs 137 in the freshwater organisms was studied during 1964 and 1965 by taking water, plankton, plant, bottom animal, and fish samples from water courses representing widely different limnological types: from eutrophic (rich in nutrients) to oligotrophic (nutrient deficient) lakes. It was shown that the Cs 137 content of all organisms sharply depends on the potassium content of the water. In lakes where this value is less than 1 mg K/l water, very high values of Cs 137 in fish were reached in 1965 - maximum 26 nCi/kg fresh weight in perch (PERCA FLUVIATILIS L.) Quantitative estimations show that the four main factors determining the Cs 137 body burdens in the last link of the food-chain, the fish are: Cs 137 content of water - a minor factor as observed differences in the lakes studied have been only about 2- to 3-fold. The limnological type of the lake - this is the main factor effecting 10- to 100-fold differences in the same fish species in different lakes. The quality of food eaten by the fish - a minor factor effecting 2- to 3-fold differences. The biological half-time of Cs 137 in fish an important factor varying from 20 to 200 days at 15 degrees Centigrade in different species and effecting up to 10-fold differences in various species in the same water course. The bulk of the Cs 137 intake takes place through food chains. Direct gill absorption plays a minor role only. (Auth)

<658>

Kolesnikov, M.V., I.A. Gorshkova, and Yu.F. Biryulin, Variations in Concentration of Carbon 14 in the Atmosphere from 1957 to 1968 (Dendrological Data). 1970, June. Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana, 6, 647-649 (Institute of Oceanology, Moscow, USSR)

Variations in radiocarbon content in pine tree trunks were studied in order to find the relationship between the C 14 increase in the yearly rings and the sudden increase of its concentration in the stratosphere. The hypothesis suggested by B. P. Konstantinov et al. on the correlation between the content of cosmogenic C 14 isotope in the yearly tree rings and the burst of supernova stars and other astrophysical phenomena was analyzed. (NSA)

<659>

Koloskov, I.A., V.V. Pisarev, and Z.L. Sinitsyna, Leaching of Strontium 90 from Some Soils and Grounds. 1968, February. Pochvovedenie, 2, 87-93

Data are presented on horizontal and vertical leaching of soils contaminated with soluble strontium 90 compounds. It was established that the leaching of this isotope depends on

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physicochemical properties and composition of the soils and amounts to 1 to 5 percent in the above stated experiments. (Auth)

<660>

Koranda, J.J., Residual Tritium at Sedan Crater. 1967. UCRL-70292; CONF-670503; Part of Nelson, D.J. and Evans, F.C. (Eds.), Proceedings of the Second National Symposium on Radioecology held in Ann Arbor, Michigan, May 15-17, 1967, 774 p. (University of California, Lawrence Radiation Laboratory, Livermore, CA)

Residual tritium from the Sedan thermonuclear detonation, 6 July 1962, was scavenged by or entrained in the 5 to 6 million tons of earth materials moved by the detonation. As a result, the Sedan post-shot environment contained a most significant biological tracer in the form of THO. Residual tritium (THO) is found in ^{235}U concentrations in the interstitial water of the Sedan throwout soil, and in the loose tissue water of plants that have re-invaded the new substratum deposited on the landscape adjacent to the crater. Tritium is present not only in the loose tissue water of vascular plants growing on the Sedan throwout, but a comparable level is also found in the tissue-bound hydrogen of these plants. Herbivores, mainly heteromylid rodents, which have re-invaded the Sedan post-shot environment and reside there, also have tritium concentrations in their body water between 1 and 3 $\mu\text{Ci/ml}$. These body-water tritium concentrations are closely related to the levels of tritium in the plant tissue-bound hydrogen. Soil-water tritium concentrations in the soil air at the rodent burrow depth are several orders of magnitude lower than the observed body-water level. The inspirational route of entry of tritium into the animal is therefore assumed to be secondary one, with the primary source being the plant organic matter synthesized in the Sedan post-shot environment which is used as the animal's food base. The internal dose to the resident mammal at Sedan Crater from residual tritium is estimated to be between 18 and 266 rad, or about 10 times that from external radiation sources resulting from the detonation. (Auth)

<661>

Koranda, J.J., and J.R. Martin, Persistence of Radionuclides at Sites of Nuclear Detonations. 1969, July 15. UCRL-71867; CONF-690303-3; 49 p. (University of California, Lawrence Radiation Laboratory, Livermore, CA)

A study of the persistence of radioisotopes at nuclear detonation sites is extremely important for evaluating future peaceful engineering uses of nuclear explosions such as the excavation of canals and harbors. Information on the distribution of radioisotopes at test detonation sites (Pacific Proving Ground and Nevada Test Site), where earth has been moved to create craters or trenches, was studied and the uptake of certain radioisotopes by plants and animals in the areas was examined. Sedan Event data on tritium concentrations in crater fallback, crater soil water, tissue water of plants growing on ejecta, and kangaroo rats living in the Sedan area are presented. Five years after the shot, tritium was found to be the most abundant radioisotope in ejecta or in any biological system in the area. (NSA)

<662>

Koranda, J.J., J.R. Martin, and E.W. Wikerink,

Residual Tritium at Sedan Crater. Part II. Soil and Ejecta Studies. 1967. UCRL-50360; 42 p. (University of California, Lawrence Radiation Laboratory, Livermore, CA)

Continuing studies of residual tritium in soil or ejecta deposited on the landscape around the Sedan Crater, Nevada Test Site, are concerned with the spatial and temporal distribution of THO in the area from the crater lip to 5000 ft from ground/zero. Seasonal variations in the concentrations of tritium in soil water occur mainly during the winter rainfall period. Dilution effects were observed to a depth of 3 ft during an unusually high rainfall period (1965 to 1966). Diluted tritium concentrations in the surface strata of soil (6 in. to 3 ft) increase to almost the predilution levels during the summer as a result of soil moisture movements. When Sedan ejecta occurs as a shallow layer overlying the preshot soil, maximum tritium concentrations are found in this soil, usually at the maximum depth of rainfall penetration, or approximately 3 ft. Maximum concentration of tritium in ejecta on the Sedan crater lip is found at a depth of 4 to 5 ft and is correlated with the depth of ejecta materials found around the crater lip. An inventory of tritium in the Sedan ejecta field was calculated, based upon collections of soil samples along transects of the ejecta-covered area, and to a depth of 6 ft at each site. The tritium inventory measurements are essentially of biologically available water in the soil system. When data are corrected to total soil-water tritium values, the current inventory of tritium outside the Sedan crater in 1967, five years postshot, is 5 to 6% of the estimated inventory of the residual tritium in the ejecta at shot time. (Auth)

<663>

Koranda, J.J., J.R. Martin, R.W. Wikerink, and M. Stuart, Radioecological Studies of Amchitka Island, Aleutian Islands, Alaska. II. Gamma-Emitting Radionuclides in the Terrestrial Environment. 1969. UCRL-50786; 44 p. (University of California, Lawrence Radiation Laboratory, Livermore, CA)

Plant and soil samples collected on Amchitka Island and in continental Alaska in 1967 and 1968 were analyzed for gamma-emitting radionuclides with conventional NaI crystal detectors and solid-state lithium-drifted germanium diodes. Of the radionuclides found in the plant and soil samples, Cs 137 was the most prominent, and Eu 135, Sb 125, Ce 144, and Mn 54 were observed in low but detectable levels. The presence of Zr/Nb in the 1967 samples suggest that fallout from Chinese atmospheric testing had been recently deposited on Amchitka Island. The environmental half-lives calculated for Cs 137 at Amchitka Island and two continental Alaskan areas ranged from 2.1 to 6.8 years. (Auth)

<664>

Koranda, J.J., J.R. Martin, and R.W. Wikerink, Leaching of Radionuclides at Sedan Crater. 1970; 1968. Advances in Chemistry Series, 93, American Chemical Society Washington, D.C.; Part of Freiling, E.C. (Chm.), Symposium on Radionuclides in the Environment held in San Francisco, California, April 1-3, 1968, (p. 97-117) (Lawrence Radiation Laboratory, Bio-Medical Division, Livermore, CA)

The distribution of tritium and long-lived gamma radioactivity was studied in crater ejecta from the Sedan detonation (July 1962). Tritium concentrations were determined in soil

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water extracted from crater ejecta samples collected from the surface to 6 feet, and at distances of 3000 feet from the crater from 1966-1968. Tritium distribution was very obviously modified by postshot environmental effects, especially rainfall leaching. Tritium maximum concentrations were found below the strata in which they were deposited. Gamma radionuclides exhibited limited movement in the crater ejecta strata or in preshot soil covered by Sedan ejecta. A subtle leaching of Cs 137 was demonstrated by considering the Cs 137/Rn 54 ratios in the ejecta strata. (Auth)

<665>

Kornberg, H.A., Radiostrontium-Calcium Relations in Plants and Animals. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 471-475), 624 p. (Hanford Laboratories, Biology Operation, Richland, WA)

In laboratory experiments the uptake in plants of Strontium 90 was measured as a function of calcium in the root environment. In general, the uptake of Sr 90 was not found to decrease as a result of the calcium present. When rats were intraperitoneally injected or fed in single doses mixtures of Sr 90 and calcium, the deposition of Sr 90 on the skeleton was not found to be affected by the presence of calcium in the administered dose. These and other experimental observations point to the need for measuring Sr 90 contamination in absolute units and tend to support theoretical considerations of the effect of isotopic dilution. The movement and deposition of substances can occur by only four processes: flow, diffusion, adsorption, and chemical reaction. Each of these processes may be separately considered to determine the effect of the addition of one isotope on the movement or deposition of another isotope. For the processes of flow and simple diffusion, isotopic dilution is without effect. For the processes of adsorption and chemical reaction, isotopic dilution will be effective only under the condition that some acceptor material upon which the element deposits approaches saturation. Even under this condition the effect of one isotope on another need not be a linear inverse relationship. Experimental data involving radioactive and non-radioactive isotopes other than radiostromium and calcium which also supported these hypotheses are presented. (Auth)

<666>

Korneev, N.A., N.I. Burov, A.N. Sirotkin, E.M. Nikolaeva, and I.Ya. Panchenko, Migration of Strontium 90 in the Biological Chain and Possibilities of Its Reduction in the Litter. The Results of Observations on Cultivated Plants and Animals. 1970. Zh. Obshch. Biol., 31, 690-697 (Institute of Biophysics, Moscow, USSR)

The highest incorporation of Sr 90 in plants of natural meadows was observed when Sr 90 was found in the surface soil. The displacement of Sr 90 down to a depth of 25 cm reduced its incorporation per plant weight unit 2 to 125 times and per 1 g Ca (Sr units) 2 to 17 times. The displacement of Sr 90 down to a depth of 30 to 40 cm reduced its incorporation still more by 1.5 to 2 times. The level of Sr 90 uptake by animals from food was related to age, functional state of the organism, and amount of Ca in the rations. The absorption

of Sr 90 in blood was much higher in young animals as compared with adults. The absorption of Sr 90 before and during egg laying in hens was 40 to 80 percent of the amount injected and decreased to 24 to 26 percent in the period between egg layings. An increased Ca content in the rations lowered the uptake of Sr 90 in animals, their progeny, and milk. A possibility is open to restrict the incorporation of Sr 90 in individual links of the biological chain: soil-plant-animals-food of animal origin. (Auth)

<667>

Korneeva, N.V., Effect of Species Specificity on the Strontium 90 Uptake by Plants from the Soil. 1970. Dokl. Vses. Akad. Sel'skokhoz. Nauk, 1, 5-7 (Not given)

A five-year program of experimentation with spring wheat was conducted with 20 species and varieties of TRITICUM. Results showed that various varieties of spring wheat differed in their assimilation tendency toward Sr 90, stable Sr, and Ca. An unequal uptake of Sr 90 per unit of Ca was noted. The possibility of selecting wheat varieties which have the smallest tendency to remove Sr 90 from the soil, both on the basis of dry weight and on the basis of the Sr/Ca ratio is discussed. (tr-Auth)

<668>

Kovalevskii, A.L., Natural Radioactive Elements in Plants. 1962. Izv. Sib. Otd. Akad. Nauk. SSSR, 4, 108-114 (Siberian Scientific Research Institute of Geochemistry, Novosibirsk, USSR)

Selective absorption of Ra, U, and Th isotopes by plants and the radioactive equilibrium of Ra isotopes and their decay products were studied. The accumulation of U, Ra, and other rare-earth elements by plants is determined by chemical rather than radioactive properties. In spite of the fact that the number of beta decays from natural radioactive element exceeds (by a factor of 3) the number of alpha decays, the ionization of living tissue by alpha particles exceeds that by beta particles, especially in leaves, flowers, and young shoots. The mesothorium and ThX (Ra 224) alpha emitters are prevalent in plants. (NSA)

<669>

Kraner, R.W., G.L. Schroeder, and R.D. Evans, Measurements of the Effects of Atmospheric Variables on Radon 222 Flux and Soil-Gas Concentrations. 1964. Part of the Natural Radiation Environment, University of Chicago Press, Chicago, Illinois, (p. 191-215) (Massachusetts Institute of Technology, Cambridge, MA)

Studies were made on the effects of barometric pressure changes, precipitation, wind, and thermal atmospheric instability on the radon 222 flux at the earth-air interface and on the radon 222 concentrations in the soil gas. The studies were conducted in the glacial debris at Lincoln, Mass., and in weathered tuff and alluvium at Nevada Test Site. The results show that: The atmosphere acts as a piston forcing radon 222-free air into the soil (rising pressure) or pulling radon 222-rich air from the soil (falling pressure). Precipitation causes a "capping effect" reducing the vertical porosity of the surface layers for radon 222 transport. High wind speeds produces a depletion of radon 222 concentrations in soil gas. Atmospheric

<669> CONT.

instability increases the flux by convection. One-dimensional diffusion equations were fitted to the data for alluvium. (NSA)

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Krasil'nikov, N.A., Role of Microorganisms in the Migration of Naturally Radioactive Elements in Rocks and Soils. 1967, September-October. Izv. Akad. Nauk SSSR, Ser. Biol., 5 714-729 (Moscow University, Moscow, USSR)

Microorganisms destroy rocks causing chemical elements, including radioactive ones to weather. Natural radioactive substances are absorbed by microbial cells to be accumulated there in the amount depending on the species and environment. The accumulation coefficient of radioactive substances ranges from 2 to 3 to 10 to 60. Fungi and yeast show the highest absorption of natural radioactive substances, lichens occupying the second place, and actinomycetes and bacteria exhibiting the least absorption. The absorption proceeds actively not only on artificial nutrient media but on the media obtained directly from rocks and soils. Having absorbed natural radioactive substances, microorganisms emit them immediately in the form of separate particles. As a rule, they emit beta-particles in a greater amount than alpha-particles. The beta/alpha ratio may vary within a significant range from 2 to 3 to 10 to 20. Microorganisms can accumulate natural radioactive substances, when occurring in plant tissues. The amount of substances accumulated in nodules is far more than that in roots or stems and leaves. Their concentration is also high in plant tissues infected with phytopathogens or symbiotes. The movement of microbial cells containing radioactive elements in rocks and soils determine the migration of these substances. Radioactive substances react with organic compounds, including microbial metabolites, to form complex and chelate compounds. They also can react with amino acids formed by microorganisms. (Auth)

<671>

Kreuzer, W., Bioindicators for Monitoring Cesium 137 Contamination of Certain Ecosystems. 1972. EUR-4800: Part of Proceedings of an International Symposium on Radioecology Applied to the Protection of Man and His Environment held in Rome, Italy, September 7, 1971, (p. 405-423) (University of Munich, Munich, German Federal Republic)

The physiological and ecological behavior of CLADONIA showed it to be a particularly suitable bioindicator for the monitoring of Cs 137 contamination of ecosystems such as those in grasslands, and land in the vicinity of nuclear installations. Previous research confirmed this supposition when certain caudexes were included in the sampling of lichens. The effect of the minimum surface size for samples, number of samples, and sampling personnel is not so important as the very uniform Cs 137 lichen contamination found in isohelvet areas, a fairly uniform topographical vegetation pattern, as a freely exposed position and the sample of entire lichens. Studies show that for representative sampling in central European conditions the number of lichen samples (single specimens or batches of microspecimens) should not be less than 10 (homogeneous growth), 20 (inhomogeneous growth) and weigh at least 2.5 g, and the sampling surface should not be less than 21 m² for batch samples. (Auth)

<672>

Krey, P.W., and E.P. Hardy, Plutonium in Soil Around the Rocky Flats Plant. 1970, August. HASL-235; 44 p. (Health and Safety Laboratory, New York Operations Office, New York, NY)

Soil samples were collected to a depth of 20 cm at 33 sites extending as far as 40 miles from the Dow Chemical Company's Rocky Flats Plant in Colorado. Deposition concentrations of Pu 239 as high as 2000 mCi/km² were found off the plant site but these high concentrations decreased rapidly with distance. The contamination pattern extends eastward from the plant in the direction of the resultant wind vector and has virtually no westward component. The pattern is incompatible with the wind direction of the day of the May 11, 1969 fire. Leaking barrels of plutonium laden cutting oil stored in the southeast corner of the plant are considered the likely source of the contaminant. Three mCi/km² of Pu 239 is the lowest contour readily discernible in the contamination pattern and extends about 8 miles east and southeast of the plant. The inventory of Rocky Flats Pu 239 within the 3 mCi/km² contour but excluding AEC controlled land is 2.6 Ci. The extent of the Rocky Flats Pu 239 beyond this contour is difficult to determine because the deposition of Pu 239 from nuclear weapon tests fallout is not precisely known in the Denver area. The cumulative fallout Pu 239 is estimated at 1.5 mCi/km² based upon a 1965 soil sample from nearby Derby, Colorado. The most distant sites at 40 miles to the east and north of the plant show a slightly higher value of 2.0 mCi/km². The intervening sites average 2.4 mCi/km². If the extreme and unlikely assumption is made that the entire area lying 40 miles to the east and north of the plant is contaminated with 1 mCi/km², an additional 3.2 Ci of Rocky Flats plutonium could have been released to these remote areas. Strontium 90 determinations for the Rocky Flats soils and other studies are in process which might resolve this uncertainty in the remote areas, but additional sampling may be required to solve the problem. The plutonium has been shown to move down into the soil as far as 13 cm, although the distribution shows wide variability apparently depending upon soil chemistry. In several cases there is as much as 60 percent of the total plutonium below 5 cm. The analytical precision of aliquoting the sample and analysis was shown to be plus or minus 20 percent. Analyses of duplicate samples taken from the same location showed similar precision indicating that the soil sampling was representative of the area studied. (Auth)

<673>

Kriedemann, P.E., Carbon 14 Translocation in Orange Plants. 1969. Aust. J. Agr. Res., 20, 291-300 (Common Scientific and Industrial Organization, Melbourne, Australia)

Translocation patterns were studied by supplying C 14 labeled CO₂ to selected source leaves under glasshouse conditions and preparing whole plant autoradiographs. The chemical nature of CO₂ fixation products was also examined. Within the actively growing shoots all currently expanding leaves showed strong import of C 14 assimilates but no export. Fully expanded leaves, borne either on a fruitful growth cycle or on a previous cycle, exported assimilates principally to nearby fruits. Sharp differences existed between adjacent fruits during their early development with respect to the level of C 14 incorporation. Mature leaves some distance

<673> CONT.

from sites of current growth activity exported principally to the root system. Old leaves between the source leaf and roots failed to import. C 14-labeled sugars comprised the bulk of radioactive assimilates in leaf, stem, and fruit 24 hr after the commencement of feeding. In the roots amino acids were the most heavily labeled fraction. C 14 photosynthate appeared to be translocated as sucrose and it was this metabolite which occurred within the outer peel of the fruit. (NSA)

<674>

Krieger, H.L., and F.J. Burmann, Effective Half-Times of Strontium 85 and Cesium 134 for a Contaminated Pasture. 1969, December. Health Physics, 17, 811-824 (Environmental Radiation Nuclear Engineering Laboratory, Cincinnati, OH)

The decrease in radionuclide concentration from a contaminated pasture, and the effect of rainfall on the removal of this deposited activity, were determined on three experimental plots (220 m²), which were prepared by transplanting the upper 10 in. of a Wisconsin-type soil profile plus a 2 in. sod layer. In the spring of 1966, 10 mCi each of Sr 85 and Cs 134 was deposited over 140 m² of this area with a controlled spraying mechanism. Portions of the grass were protected from precipitation by automatically closing covers. The height of the grass in discrete plots was 2 in. or 6 in. Replicate samples from the protected plots were clipped at intervals of 1 to 8 days, while the exposed sections were sampled after each of the 20 rains during the 75 day experiment. The disappearance curves, from a statistical analysis of the activity per dry weight, showed two effective half-times. For the protected areas, the first component was approximately ten days for Sr 85 and fifteen days for Cs 134. The second component for both tracers ranged from 25 to more than 50 days. Samples from the exposed areas were generally lower in activity after each rain. The first half-time component for Sr 85 and Cs 134 averaged 3 to 4 days, respectively, whereas the second component for the exposed area ranged from approximately 25 to more than 50 days. (Auth)

<675>

Krieger, H.L., B. Kahn, and S.L. Cummings, Deposition and Uptake of Strontium 90 and Cesium 137 in an Established Pasture. 1966. CONF-660405; Part of Aberq, B. and Hunkate, F.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, (p. 59-71), 105p. (U.S. Department of Health, Education, and Welfare, Public Health Service, Radiological Health Research Activities, Research Branch, Division of Radiological Health, Cincinnati, OH)

The accumulation of strontium 90 and cesium 137 in bluegrass was determined. The fraction of three nuclides derived from the soil was determined by the quantity of stable strontium and cesium taken up by the plant and compared to grass analysis grown under cover. (CNF)

<676>

Krotoszyner, J.P., and R. Kirchmann, Contribution to the Study of the Retention of Strontium 90 in Soil. 1961. Pedologie, 11, 44-59 (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium)

A study was made of the retention of Sr in

three types of soil taken from the Gembloux, Mol, and Morhet regions (Belgium). Two horizons for each of the soils were chosen and the content of humus, clay, and calcium in each was determined. A granulometric analysis of these substrata was also carried out. In the first series of experiments, the soils were introduced into percolation columns and saturated with Strontium 85 and Strontium 87. A BaCl₂ solution was then percolated through the soil column to flush the Sr retained by capillarity and to determine the exchangeable fraction of strontium. Results showed that exchange proceeded rapidly and that absorption was mainly influenced by clay and humus. In a second series of experiments, three surface horizons of soil were shaken in the presence of carrier-free Strontium 90. Results showed that the examined horizons displayed no differences in absorption rate or in quantity of retained Strontium 90. Under the conditions of these experiments, the retained amounts of Strontium 90 varied from 89.3 to 97.8 percent, according to the horizon and the shaking period employed. Extensive shaking of soil with Sr solutions produced a slight reduction in retention values and was thought to result from exchange of desorbed soil ions with absorbed Sr. It was concluded that Sr 90 uptake by soil is rapid, nearly complete, and similar in different soil types. (NSA)

<677>

Kulikov, N.V., Influence of Certain Complexons on Radioisotope Sorption by Soil. 1968. Tr. Inst. Ekol. Rast. Zhivotn., 61, 21-25

The greatest efficiency for reducing the sorption by the soil of radioisotopes of cobalt, zinc, cadmium, cerium, and ruthenium was obtained with EDTA and DTPA, and calcium and strontium-EDTAP and DTPA. All of the chelates were ineffective for the radioisotopes of rubidium, silver, and cesium. EDTA and DTPA are of interest for further study under growing conditions and also in field experiments with the purpose of increasing the migration capability of cobalt, zinc, cadmium, cerium, and ruthenium isotopes in more complex soil-solution-plant. (tr-Auth)

<678>

Kulikov, N.V., Effect of Ethylenediaminetetraacetate on the Mobility of Radioactive Isotopes of Strontium, Cesium, and Some Other Elements in Soil. 1965. Soviet Soil Science, 6, 678-681 (Academy of Sciences, Urals Branch, Institute of Biology, USSR)

Additions of EDTA to the soil appeared to form stable chelates with many of the radioisotopes studied and enhance the plant uptake of three elements. Cobalt chelates appeared to remain stable for a long time. (CNF)

<679>

Kulikov, N.V., Cobalt Absorption by Plants in Relation to the Humus Content in Soil. 1961. Soviet Soil Science, 2, 428-430 (Academy of Sciences, Urals Branch, Institute of Biology, USSR)

Plants grown on coarse-textured soils, with less organic matter, will tend to have greater quantities of cobalt than those grown on heavy texture soils with more organic matter. The quantity of cobalt present in plants is largely located in the roots rather than in leaves, indicating its low mobility within the plant. (CNF)

<680>

Kulikov, N.V., and N.M. Korobitsyn, Effects of the Vegetable Cover on the Vertical Migration of Cerium 144 in the Soil. 1968. Tr. Inst. Ekol. Rast. Zhivotn., 61, 47-54 (Academy of Sciences, Urals Branch, Sverdlovsk, USSR)

The effect of perennial alfalfa on the vertical migration of Cerium 144 in soil was studied. Upon addition in the superficial layer of soil (0 to 2 cm) for 14 months, including two summer seasons, cerium penetrated soil without a plant cover to a depth of 10 cm and in soil with plants to a depth of 30 cm. In this and other cases, most of the cerium (86 to 88 percent) remained in the area of application. The transport of cerium by the above ground parts of plants for two growing seasons represented 0.01 percent of the amount introduced into the soil. The plant roots accumulated approximately the same amounts. The coefficient of the accumulation of cerium for the above ground parts of alfalfa was 0.004 to 0.005 and for the roots in the area of soil where the cerium was introduced it was 0.04. In the above ground parts of alfalfa, cerium was accumulated mainly in the leaves, while in the root system it was accumulated in the areas that were in immediate contact with the radioisotope contaminated soil. The degree of fixing of Cerium 144 in the soil did not depend on the time of its contact with soil particles. In soil on which plants were growing, an increase in the desorption of cerium by the cations of potassium, sodium, and calcium was noted. (tr-Auth)

<681>

Kulikov, N.V., S.A. Lyubimova, and N.A. Timofeeva, Strength of Fixation of Strontium 90 and Cesium 137 by Living and Dead Tissues of Freshwater Plants. 1968. Radiobiologiya, 8, 760-763 (Institute of Plant and Animal Ecology, Sverdlovsk, USSR)

The elimination of Cs 137 and Sr 90 by living and dead tissues of three species of fresh water plants (Cladophora, moss, and hornwort) was studied under experimental conditions. It was established that both radioisotopes are eliminated comparatively easily from a dead plant substrate and with somewhat greater difficulty (especially Cs 137) from living plants. The data obtained reveal the predominant role of exchange mechanisms of the fixation of strontium and cesium both in living and in dead plants. (NSA)

<682>

Kulikov, N.V., S.A. Lyubimova, and D.G. Fleishman, Accumulation of Cesium 137 by Freshwater Plants Under Experimental Conditions and in Natural Water Basins. 1968. Dokl. Akad. Nauk SSSR, 178, 1407-1409 (Institute of Plant and Animal Ecology, Moscow, USSR; Institute of Evolution Physiology and Biochemistry, Moscow, USSR)

Comparisons were made of the uptake of Ce 137 by various freshwater plants under natural and simulated conditions. Fresh water plants from the Large Maiss and Large Taktul lakes in the South Urals were collected for the studies. The recording efficiency for gamma-quanta recording of Ce 137 in the band energy from 610 to 710 keV was 20% with the background of 24 pulse/min. Tabulated data of the cesium-137 uptake by 25 types of fresh-water plants showed that some species exhibited a much more active uptake of the cesium-137 than others: this was best observed in the cesium content of the ash residue. The highest

uptake among the algae was observed in the SPIROGYRA sp. and CHARA FRAGILIS. The moss, DREPANOCALADUS SENDTNERI, exhibited a very high level of uptake, and among the higher species, the highest uptake was observed in duck weed (LEMNA MINOR L.). Average content in ash changed in the following order: moss greater than floating plants greater than algae greater than off shore water plants greater than submerged plants; for the dry mass: moss greater than algae greater than floating plants greater than offshore water equals submerged plants. (NSA)

<683>

Kulikov, N.V., S.A. Lyubimova, and N.A. Timofeeva, The Role of Freshwater Plants in Processes of Coprecipitation of Strontium 90 with Calcium Carbonate. 1970. Ecology (USSR), 4, 315-317 (Academy of Sciences, Urals Branch, USSR; Institute of Plant and Animal Ecology, Sverdlovsk, USSR)

It was established that strontium 90 is incorporated together with calcium into carbonate compounds, formed in the water as a result of the vital activity of plants. During the transfer of these elements to the carbonate deposit, there is a discrimination of strontium 90 relative to calcium with a discrimination coefficient of 0.3. It is suggested that the process of carbonate formation occurs on the surface of the plants. (Auth)

<684>

Kulikov, N.V., I.V. Molchanova, and E.N. Karavaeva, Influence of the Conditions of Soil Moisture on the Passage of Strontium 90, Cesium 137, and Cerium 144 From the Soil into Solution. 1973. Soviet Journal of Ecology, 4(4), 320-323 (Institute of Plant and Animal Ecology, Urals Scientific Center, USSR)

It was shown experimentally that with increasing soil moisture content the amounts of Cs 137 and Ce 144 in the equilibrium solution increase sharply, while the content of Sr 90 changes less substantially. It has been suggested that the seasonal drops in the soil moisture content under natural conditions are among the causes of the equalization of the rates of vertical migration of the radionuclides studied in the soil. (Auth)

<685>

Kulikov, N.V., and I.I. Piskunov, Effect of Lucerne on Vertical Migration of Cobalt and Cesium in Soils. 1969. Agrokhiimiya, 2, 109-115

Data from field experiments revealed that downward movement of cobalt and cesium was accelerated in areas with vegetative cover compared to bare soil. The enhanced movement was thought to be caused by transport within the plant-root system rather than movement through soil. (CWF)

<686>

Kulikov, N.V., and I.I. Piskunov, Role of Plants in the Vertical Migration of Strontium 90 and Cesium 137 in Soil. 1970. Agrokhiimiya, 7, 115-121 (Institute of Plant and Animal Ecology, Sverdlovsk, USSR)

The quantity of Sr 90 carried from the upper layer of prairie-grass covered soil by the above ground parts of alfalfa and a variety of related plants during one growing season was less than 0.1% of the amount introduced into the soil. The quantity of Cs 137 carried

<686> CONT.

depended on the composition of the cover grass, the plant biomass, and the length of the growing season. It varied from 0.001 to 0.01% of the amount introduced. In the root system of the plants, the strontium content reached 0.1% and the cesium content 0.01%. Also, both radioisotopes were accumulated mainly in the part of the roots first contacted by the contaminants in the upper layer of the soil. Over a period of 39 months, in soil lacking a plant cover, both radioisotopes migrated from the contaminated upper layer of the soil to a depth of 15 to 16 cm. In this case, the nature of their vertical distribution in the soil was exponential. In soils with a plant cover, the radioisotopes penetrated to a depth of up to 20 cm, and the nature of their vertical distribution was best expressed as a power function. The vertical migration parameters for Sr 90 and Cs 137 in soil with a plant cover and soil without a plant cover were comparable. (tr-Auth)

<687>

Kulp, J.L., W.R. Eckelmann, and A.R. Schulert, Strontium 90 in Man. 1957. Science, 125, 219-225 (Columbia University, Lamont Geological Observatory, Palisades, NY)

Global distribution of fallout strontium is presented and its pathways to man are discussed. (CWF)

<688>

Kulp, J.L., A. Kaufman, R.S. Hirshman, and A.R. Schulert, Strontium 90 in the Soils of the New York City Area. 1962. Annals of the New York Academy of Sciences, 93, 763-773 (Columbia University, Lamont Geological Observatory, Palisades, NY)

Maximum deposition of fallout strontium 90 was about 70 mc/mile² in the summer of 1961. The concentration of strontium 90 in a soil profile decreases exponentially with depth, i.e., 70-75 percent is in the upper 2 inches and 90-99 percent is in the upper 6 inches. (CWF)

<689>

Kulp, J.L., R. Slakter, and A.R. Schulert, Strontium 90 in Food. 1959. J. Agr. Food Chem., 7, 466-469 (Columbia University, Lamont Geological Observatory, Palisades, NY)

The magnitude and character of fallout radiostrontium in food products are described. Several soil management practices are suggested which will lower transfer of strontium 90 from soil to plants. (CWF)

<690>

Kunishi, H.M., and A.W. Taylor, Adsorption of Calcium and Strontium by Crandallite. 1968. Soil Science Society of America Proceedings, 32, 441-442 (U.S. Department of Agriculture, Soil and Water Conservation Research Division, Soils Laboratory, Beltsville, MD)

Samples of the phosphate mineral crandallite, CaAl₃(PO₄)₂(OH)·5H₂O were equilibrated with solutions containing calcium and strontium chlorides labelled with Ca 45 and Sr 85. The apparent selectivity coefficient for the equilibrium system, calculated from the isotopic dilution, varied from 1.5 at pH 9.3 to 8.2 at pH 4.7. The mineral has limited value as a scavenging agent for the removal of strontium from soil. (Auth)

<691>

Kunishi, H.M., and A.W. Taylor, Immobilization of Radiostrontium in Soil by Phosphate Addition. 1972, January. Soil Science, 113, 1-6 (U.S. Department of Agriculture, Beltsville, MD)

The results show that alkaline orthophosphate salts can be used to immobilize up to 98 percent of the calcium and strontium ions in the upper layers of soil, when applied in sufficient quantity to the surface of the undisturbed soil. The addition of smaller amounts of fluoride with the phosphate enhances the reaction and reduces the amount of phosphate needed. Equilibration of treated samples for up to 110 days showed that there is little change in the amount of strontium immobilized after the initial reaction. (Auth)

<692>

Kvaratskhelia, N.T., and G.M. Arnautov, Uptake of Radio Strontium by Cereals from the Soils of Georgian SSR. 1967, March. Pochvovedenie, 3, 110-115 (Institute of Soil Science, Agrochemistry, and Soil Conservation, Academy of Sciences, Georgian SSR, USSR)

Strontium 90 uptake by oats and wheat dropped as the water solubility of strontium was decreased. A more effective method for producing a decrease in Strontium 90 uptake was achieved by adding farm-manure and phosphorus fertilizers to the soil. The same effect was observed when lime was added to acid soils. Strontium 90 acquisition by plants decreased as the soil fertility and amount of plant nutrients in the soil was increased. (Auth)

<693>

Kvaratskhelia, N.T., and G.L. Glonti, Movement of Strontium 90 in Georgian Soils. 1965. Soviet Soil Science, 10, 1187-1193 (Institute of Soil Science, Agrochemistry, and Soil Conservation, Georgian SSR, USSR)

Russian data, in Georgian soils, indicate radio-strontium can reach soil depths as great as 80 cm in readily permeable soils under abundant rainfall. The topography of the region plays a major role in accumulation of radiostrontium within soil groups, i.e., greatest in hollows and depressions with the least in rolling and steep slopes. (CWF)

<694>

L'Annunziata, M.F., and W.H. Fuller, The Chelation and Movement of Strontium 89-Strontium 90 (Yttrium 90) in a Calcareous Soil. 1968. Soil Science, 105, 311-319 (University of Arizona, Agricultural Experiment Station, Tucson, AZ)

The influence of synthetic chelating agents on the movement of radiostrontium through soil with leaching was studied. Phosphomolybdotungstic acid (Polin-Ciocalteu Reagent) was found to serve as an excellent indicator for chelons, producing a blue color with the addition of Na₂CO₃. This color reaction was used in combination with paper electrophoresis to obtain experimental evidence indicating the presence of radionuclide-complexes in the soil solution as formed by the synthetic chelating agents. Movement and displacement of radiostrontium by EDTA, EGTA, DCTA, HEEDTA, and DTPA were evaluated in columns of Mohave sandy loam soil. The displacement of Sr 89 from the soil columns was 19, 38, 44, 47, and 81

<694> CONT.

percent in the order: HEEDTA < DCyTA < EDTA < EGTA < DTPA. Only 5 percent of the radiostrontium was leached out of the columns in the absence of synthetic Sr (II)-chelating agents. Radionuclides occurring naturally and possible from fallout were leached from the Mohave soil with DTPA and constituted less than 0.2 percent of the radioactivity added to the soil. The profile distribution of sodium acetate-extractable radiostrontium remaining in the soil columns after leaching was most strikingly contrasted between the DTPA and the untreated columns. Trace amounts of radioactivity were detected in the upper centimeters of the DTPA-treated soil, whereas much greater amounts remained in the upper few centimeters of the control columns. The radionuclides existed as negative complexes formed by the synthetic chelating agents applied. Any natural organic chelating agents in the soil did not influence radio-strontium movement, nor did they influence chelation to any appreciable extent. (Auth)

<695>

Lachet, B., J. Gagnaire, and R. Plebin, Ruthenium 106 Distribution in a Reduced Model Simulating River-Banks: Some Hydrodynamic and Kinetic Aspects of its Adsorption on Sediments. 1972. CEA-R-4304; 28 p. (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Grenoble, France)

Study of the behavior of nitrate-nitrosyl Ru 106 introduced into the aqueous medium of a reduced model (245 x 110 x 100 cm) to simulate a river bank, has confirmed the orders of magnitude obtained both for concentration factors of this element in aquatic plants, and for its weak upward mobility in aerial parts of semiaquatic plants. On the other hand, after crossing into the bank, the complex undergoes transformation, and, as a result, passes up into the aerial organs of SALIX PURPUREA, POPULUS NIGRA, and PHRAGMITES COMMUNIS. The effects of hydrodynamic conditions on the adsorption of Ru 106 in Isere sediments have been studied in columns (o = 30 cm; h = 2 m): rinsing with uncontaminated water partially displaced the radio-element; at constant concentration of contamination it was accumulated on the surface. The flow used was as closely as possible the downwards flow to the natural underground water-level. Finally, kinetic properties of a water purification by sediments in suspension can be interpreted as a function of time by an equation of the form $(Ru) = (Ru)_{sub 0} (1+t/a)^{(F+n)}$ where a and n are two parameters fixed by the least-squares method. (Auth)

<696>

Laeuchli, A., Uptake of Strontium by Higher Plants in Mixed Cultures. 1966. Ber. Schweiz. Bot. Ges., 76, 239-246 (University of Basel, Basel, Switzerland)

The uptake of strontium by single and mixed cultures of ZEA MAYS and PISUM SATIVUM was investigated. There were no differences between the two culture conditions for maize, but the uptake by PISUM was higher in mixed than in single cultures. This increased uptake of strontium comes from the change of pH in the culture solution from pH 4.1 to about pH 6.5. No similar influence of pH was found for maize. The results represented a case of ion competition between higher plants. (Auth)

<697>

Lagerwerff, J.V., and M. Peech, Relation Between Exchange Adsorption and Accumulation of Calcium and Rubidium by Excised Barley Roots. 1961. Soil Science, 91, 84-93 (Cornell University, New York State College of Agriculture, Ithaca, NY)

Excised barley roots were exposed to solutions containing various ratios of the Rb/Ca activity at constant ionic strength and solutions containing various sets of ionic strength but at a constant Rb/Ca activity ratio. The uptake of the two ions was found not to be directly related to the relative amounts of the two cations on the exchange sites. At low Ca concentrations there occurred a stimulative effect of uptake by Rb. (CHF)

<698>

Lahoud, A., and N.R. Piper, An Improved Method for the Determination of Strontium 90 in Soils and Sands. 1967. CONF-670512: STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 1-23) (Australian Atomic Energy Commission Research Establishment, Lucas Heights, Australia)

The method used for determination of Sr 90 in Environmental materials was subject to interference from large concentrations of iron and aluminum in soil extracts. A suitable solvent extraction procedure was developed that will remove iron and aluminum without itself interfering in the determination. The method selected was the extraction of iron and aluminum acetylacetonates into chloroform at controlled values of pH. This procedure removed more than 95 percent of both iron and aluminum and produced no undesirable complications. Normal recovery of strontium was better than 80 percent. (Auth)

<699>

Lai, T.H., and M.M. Mortland, Cationic Diffusion in Clay Minerals: I. Homogeneous and Heterogeneous Systems. 1968. Soil Science Society of America Proceedings, 32, 56-61 (University of Michigan, Agricultural Experiment Station, Ann Arbor, MI)

Models of homogeneous and heterogeneous cationic diffusion systems were applied to clay minerals. The diffusion of Na and Ca ions in expanded Na-vermiculite, which has both internal and external surface available for cationic diffusion, decreased with increasing diffusion time, a characteristic of heterogeneous systems. Diffusion of those ions remained essentially constant in collapsed K-vermiculite which has only external surface available for diffusion and can thus be described as homogeneous. The property of homogeneity was further confirmed with cationic diffusion in the vermiculite whose exchange sites were clogged by p-phenylenediamine cation, and in Na- and K-kaolinite; while the heterogeneous property was observed for Na- and K-bentonite. The diffusion of Na ion in Na-vermiculite was related to a model originally derived for mathematical analysis of grain boundary problems. The evaluation of diffusion coefficients of external surface (D_e) and of interlayer surface (D_i) was made, and D_e of Na ion in Na-vermiculite was found to be about 5 times larger than that of D_i . The importance of considering the homo- and heterogeneity of the system in the study of cationic diffusion in clay minerals is suggested. (Auth)

<700>

Lakonen, E., and A. Paasikallio, Effects of Soil Factors on the Uptake of Radiocesium by Plants. Part II. 1970. Ann. Agr. Fenn., Ser. Agrogeol., Chim. Phys., 9 (46), 133-138 (Agricultural Research Center, Tikkurila, Finland)

The effects of increasing the contents of organic matter, clay, and inactive strontium in soil on the uptake of radiocesium by plants are presented. The pot experiment with timothy was carried out using three entirely different soil types: Sphagnum peat, heavy clay, and fine sand. The soils were contaminated with 40 uCi of Sr 89 per pot, and timothy was sown, harvested after six weeks and analyzed. In the case of inactive strontium content, there was also another portion of the soils to which 80 uCi of Sr 89 was added per pot and allowed to equilibrate to one half life of Sr 89 (53 days). The mixing of Sphagnum peat in sand reduced the plant uptake of Sr 89 by a factor of 7 and the Sr 89/Ca ratio by a factor of 3 when the contents of soil organic carbon were increased from 1 to 15 percent reduced the Sr 89/Ca ratio in the plant to a lesser extent but gave the same result at a higher clay level. The naturally high content of inactive soil strontium decreased the Sr 89/Ca ratio in plants in the following order: fine sand greater than heavy clay greater than Sphagnum peat. The application of inactive strontium to previously contaminated soils reduced the Sr 89/Ca ratio of the plants in fine sand and heavy clay but increased it in Sphagnum peat. (NSA)

<701>

Lakonen, E., and A. Paasikallio, Effects of Soil Factors on the Uptake of Radiocesium by Plants. Part I. 1968. Ann. Agr. Fenn., Ser. Agrogeol., Chim. Phys., 7, 89-94 (Agricultural Research Center, Tikkurila, Finland)

The effect of soil type and pH on the uptake of Sr 89 by timothy was studied in a pot experiment. The increase of soil pH reduced the uptake of Sr 89. The effect of soil type was more pronounced and the Sr 89/Ca ratio of the plant clearly decreased in the order: finesand, heavy clay, Sphagnum peat, and Carex peat. (Auth)

<702>

Lane, W.B., Fallout Simulant, Final Report, Final Report Development: Leaching of Fission Products from Nevada Fallout and Properties of Iodine-Tagged Simulant. 1970, June. AD-717281; 56 p. (Stanford Research Institute, Menlo Park, CA)

Long term leaching studies were conducted with field samples collected at SMALL BOY, JOHNNIE BOY, and SEDAN. Fallout from each of these nuclear events was leached by 0.1N HCl (to represent stomach acid) and distilled water. The leaching mechanism for the removal of eight year old fission products from SMALL BOY fallout by 0.1N HCl appears to be controlled by a sorption reaction for a few days, after which it is controlled by a diffusion process. Leaching of SMALL BOY fallout by 0.1N HCl removed 60 percent of the activity from large particles and 30 percent from small particles. Leaching by water removed only a few percent of the activity. Generally less than 10 percent of the activity was removed from JOHNNIE BOY or SEDAN fallout by either 0.1N HCl or water. A method was developed for safe production of radiiodine tagged synthetic fallout with a wide range of soluble or available iodine. (Auth)

<703>

Lane, W.B., J.D. Sartor, and C.F. Miller, Plant Uptake of Radioelements from Soil. 1964. SRI-IM-4536 (U.S. Department of Defense, Office of Civil Defense, Washington, DC)

This report presents a model for predicting food crop contamination by root uptake of radionuclides. The model was tested with existing data to obtain equation constants which would permit a solution for a hypothetical contaminating event. Values for many crop-isotope combinations were estimated or assigned because of lack of data. The derived or estimated constants for important agricultural crops are summarized for computer input. Results of a nationwide survey to obtain the exchangeable calcium content of the soil in each county of the United States are presented. (Auth)

<704>

Langham, W.H., The Problem of Large-Area Plutonium Contamination. 1968. WP-18208; Seminar Paper No. C02, Part of Selected Papers from the Bureau of Radiological Health Seminar Program, 1968, 8 p. (Los Alamos Scientific Laboratory, Los Alamos, NM)

After a brief review of the physiology and toxicology of plutonium, three examples of large area plutonium contamination are described. Both the physical and biological basis for action seems inadequate or hopeless. Until more meaningful approaches are developed for evaluating risk from the high specific-activity particle, there is little alternative but to continue trying to relate exposure situations to current NCRP recommendations. (BBM)

<705>

Langham, W.H., and , Biological Implications of the Transuranium Elements for Man. LA-DC-13083; CONF-710919-4; 32 p. (University of California, Los Alamos Scientific Laboratory, Los Alamos, NM)

This is a paper presented at Conf-710919-4, on the history and future problems associated with the entry of plutonium into the biological cycle. (CWF)

<706>

Larson, P.R., Interpretation of Radioisotope Translocation Patterns in Forest Trees. 1971. CONF-711213; IAEA/SM-151/35; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971, (p.1-11) (U.S. Department of Agriculture, North Central Forest Experiment Station, Forest Service, Rhinelander, WI)

A brief review of the literature concerning translocation of radioisotopes in forest trees indicated that in past research little attention has been focused on the vascular anatomy of the tree. (CWF)

<707>

Lathwell, D.J., W. Sanchez, D.J. Lisk, and M. Peech, Availability of Soil Phosphorus as Determined by Several Chemical Methods. 1958. Agronomy Journal, 50, 366-369 (Cornell University, New York State College of Agriculture, Department of Agronomy, Ithaca, NY)

Methods employing an anion-exchange resin were

<707> CONT.

found to predict with a high degree of accuracy the phosphorus needs of soils as determined by crop responses to applications of phosphatic fertilizer. (Auth)

<708>

Leavitt, V.D., and B.J. Mason, Soil Survey of Area 15 Nevada Test Site. 1971, June. SWRHL-106-r: 46 p. (Western Environmental Research Laboratory, Las Vegas, NV)

The results of a soil survey of the area around the Environmental Protection Agency Experimental Dairy Farm located in Area 15 of the U.S. Atomic Energy Commission's Nevada Test Site are reported. Four soil series were identified. Descriptions of these series are included along with physical and chemical analyses of representative samples of the soils. (Auth)

<709>

Lee, C.C., Uptake of Strontium 85 by Alfalfa. 1962. Science, 138, 41-42 (University of Saskatchewan, Department of Chemistry, Saskatoon, Saskatchewan, Canada)

Experiments with alfalfa were carried out to study the possibility of changes with time in the availability of radiostrontium in soil. After the soil was treated once with Sr 85, the first crop was harvested after 60 days of growth. Four subsequent crops, cut at successive 4-week intervals, were examined. The difference in uptake between the second and fifth crops was statistically significant, suggesting that some fixation of Sr 85 may occur in the soil. The effects of various applications of ammonium dihydrogen phosphate, monocalcium phosphate, calcium chloride, and potassium chloride on the uptake of Sr 85 by alfalfa were also investigated. Of the experiments carried out, only the treatment with 1.0 meq of potassium per 100 g of soil resulted in a statistically significant reduction in strontium uptake. (Auth)

<710>

Lee, C.C., Effects of Plant Nutrients on Uptake of Radiostrontium by Thatcher Wheat. 1961. Science, 133, 1921-1922 (University of Saskatchewan, Department of Chemistry, Saskatoon, Saskatchewan, Canada)

The effects of various dosages of ammonium dihydrogen phosphate, monocalcium phosphate, calcium chloride, and potassium chloride on the uptake of radiostrontium by Thatcher wheat grown in Saskatchewan Oxbow loam soil containing strontium 85 were studied. Monocalcium phosphate at a dose level of about 600 lb/acre of soil effected a statistically significant reduction of strontium 85 uptake in each of the four plant fractions of grain, chaff, stem, and leaf. At the very reasonable dosage of about 60 lb/acre, monocalcium phosphate gave a statistically significant reduction in strontium 85 uptake in the grain and chaff. (Auth)

<711>

Lee, C.C., and F.W. Sosulski, Uptake of Strontium 85 by Cereal Crops and Varieties. 1965. Can. J. Plant Sci., 45, 13-17 (University of Saskatchewan, Department of Chemistry, Saskatoon, Saskatchewan, Canada; University of Saskatchewan, Department of Crop Science, Saskatoon, Saskatchewan, Canada)

Twenty-nine varieties of wheat, oats, barley,

and rye were grown to maturity in the greenhouse on Oxbow loam treated with Sr 85. Based on the average uptake of Sr 85 per gram of whole plant material, the ranking of the cereal crops in order of decreasing Sr 85 uptake was rye, barley, oats, and wheat. Significant differences in Sr 85 uptake between varieties within crops of wheat, oats and barley were demonstrated. The range of values for varieties within crops overlapped those of other crops, the variability being greater in wheat and barley than in oats. These results suggest that the validity of assessing differences between crops on the basis of single varieties to represent each crop may be questionable. Leaves accumulated the highest percentages of Sr 85 and gave good prediction of the percentage uptake by the whole plant. The Sr 85 accumulated in dehulled seeds was very small and appeared to be unrelated to whole plant values. (Auth)

<712>

Lehr, J.J., Indirect Radioactive Contamination of the Food Chain Determination of the Factors of Transfer Soil/Agricultural Produce and Soil/Milk in the European Community. 1972. EUR-4901-e (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France)

An investigation was carried out under practical conditions to determine factors for the transfer of Sr 90 and Cs 137 from soil to food products, by making use of the cumulative deposit of these radionuclides resulting from fallout in the soil. Analyses were made of both crops and soils on which they had been cultivated. Special attention was paid to the variation of the soil factors concerned as a function of the properties of the soil, i.e. in the case of Sr 90 of the contents of the soil of exchangeable calcium and of calcium carbonate and in the case of Cs 137 of the contents of the soil of clay, organic matter and potassium. In acid and neutral soil the soil factor for Sr 90 was found to be negatively correlated with the exchangeable Ca. Against expectation it shows a tendency to increase in calcareous soils with the CaCO₃ content, in particular above contents of 10%. In cases where several samples of fodder crops (grass and lucerne) were harvested on the same field in the course of the growing period seasonal variations occurred, to the effect that after an initial high contamination in spring a pronounced drop in summer followed. In autumn the tendency was rather to increase again. It is assumed that the effect depends mainly on fluctuations of the degree of humidity of the soil. (Auth)

<713>

Lehr, J.J., and R. Kirchmann, The Contamination by Radiostrontium and Radiocesium of Grassland in Relation to the Age of the Deposition and to the Organic Matter in the Soil. 1973. Int. J. Environ. Stud., 5, 99 (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Fontenay-aux-Roses, France)

The effect of soil organic matter in the transfer of radionuclides is described. The distribution of strontium 85 and cesium 134 in the mineral and organic matter fractions of soils, and their passage into grass are discussed. Organic matter can temporarily retain part of a recent deposition in the soil. The effect depends on the amount of organic matter and clay fractions in the soil. (ST)

<714>

Lenaers, W.M., Photochemical Degradation of Sediment Organic Matter: Effect on Zinc 65 Release. 1971. RLO-2227-T-12-32; Ph.D. Thesis; 64 p. (Oregon State University, Corvallis, OR)

Columbia River sediment was irradiated with ultraviolet light to determine if organic material could be removed without altering the sorptive properties of the hydrous oxides of iron and manganese. A laboratory preparation of Zn 65-spiked hydrous ferric oxide was subjected to ultraviolet irradiation in order to assess the photochemical effect upon Zn 65 release. The photochemically induced release of Mn 54 present on the Columbia River sediment was used to assess the effect on the hydrous oxides of manganese. The ultraviolet irradiation proved effective in removing up to 68 percent of the sedimentary organic material in 17 hours without causing release of Zn 65, Sc 46, or Co 60. While the ultraviolet irradiation had no effect upon Zn 65 release from laboratory preparations of hydrous ferric oxides and Zn 65 spiked montmorillonite, a significant release of Mn 54 resulted from the photolysis treatment. The removal of Mn 54 was not accompanied by the release of sorbed Zn 65 or Sc 46 (nuclides expected to be sorbed by hydrous oxides), nor did there appear to be any permanent change in the nature of the Mn 54 on the sediment. Although it is possible that the hydrous oxides of manganese are affected by the ultraviolet treatment, it is likely that another species, such as the carbonate, is the species involved. Photooxidation appears to provide a method of obtaining sediments with substantially reduced organic content without affecting the sorptive properties of hydrous oxides or clay minerals. This result should allow the use of uptake studies to determine the importance of organic material in trace metal sorption by sediments. (Auth)

<715>

Lerman, A., and H. Taniguchi, Strontium 90--Diffusional Transport in Sediments of the Great Lakes. 1972, January. J. Geophys. Res., 77, 3, 474-481 (Canada Centre for Inland Waters, Burlington, Ontario, Canada; Canada Department of National Health and Welfare, Radiation Protection Division, Ottawa, Ontario, Canada)

Penetration depth of Sr 90 in deep-water sediments of Lake Superior and Lake Ontario was 8-10 cm by 1969. Detailed picture of the Sr 90-containing layer indicates that the main mechanisms of transport from lake water into sediment are (a) diffusion of Sr 90 in interstitial water, and (b) uptake of Sr 90 by solid phases in sediment. A diffusional transport model, with diffusion coefficient $D = 2 \times 10^{-6} - 4 \times 10^{-6} \text{ cm}^2 \text{ sec}^{-1}$ and distribution factor $K=120-440$ in favor of solids, gives Sr 90 concentrations in sediment comparable with observed values. Intensity of diffusional flux into sediment increases with greater uptake by solids (larger values of K). In Lake Ontario, flux into sediment has been removing Sr 90 from lake water at the rate of 0.2-0.5 percent per year, during the period 1954-1969. The slowness of flux compared with the rate of Sr 90 removal in lake outflow (12 percent per year) accounts for the small amount accumulated in sediments (4-6 percent of Sr 90 in lake water) and for the lack of noticeable control of concentrations in lake water by floor sediments. (Auth)

<716>

Letey, J., and A. Klute, Apparent Mobility of Potassium and Chloride Ions in Soils and Clay

Pastes. 1960. Soil Science, 90, 259-265 (University of Illinois, Department of Agronomy, Urbana, IL)

Potassium and chloride mobilities (apparent) were determined in three soil materials at various concentrations through data from transference numbers and specific conductance. The apparent mobility of potassium increased as salt concentration increased while that of chloride decreased on increasing salt concentration. (CNF)

<717>

Levi, E., The Distribution of Mineral Elements Following Leaf and Root Uptake. 1968. Physiologia Plantarum, 21, 213-226 (Euratom-Ital, Wageningen, Netherlands)

The initial and subsequent distribution of Na 22, K43, Rb 86, Cs 134, P 32, S 35, Ca 45, Zn 65 and Sr 85 in bean plants, following leaf and root uptake was studied under controlled environmental conditions. Autoradiographic and counting methods reveal vascular connections between leaves and roots and two patterns of distribution in the leaves following root uptake are reported. Distribution following treatment of specific parts of the leaves or roots points to a morphological unity in the bean plant. A possible circulation pattern for some ions is discussed. (Auth)

<718>

Levi, E., The Penetration and Adsorption of Cesium in Bean Leaves. 1969. Acta Bot. Neer., 18, 455-461 (Euratom, Wageningen, Netherlands)

The foliar uptake of Cs 134 in the leaves of beans (PHASEOLUS VULGARIS) was studied under conditions of varying temperature, humidity, and air flow on the leaf surface. Leaf treatment consisted in applying 0.01 ml aqueous solution of 1 mCi Cs 134 labeled CsCl containing 0.1 uCi Cs 134 to the tip of one primary leaf of plants, the first trifoliate of which was expanding. At various times after treatment the fraction of Cs 134 not retained by the plant was washed off the treated area and the plant harvested in separate fractions to determine the amount still held in the treated area as well as the distribution of the Cs 134 taken up. At constant relative humidity (RH), the air temperature played a role in Cs uptake. One hour after treatment 98.0, 85.6, and 80.0% of the total applied Cs could be removed by washing the treated leaves of plants at 15, 23, and 30 degree C. The quantity held in the treated area, while very low at 15 degree C (1.1%) was considerably greater (14.2%) at the optimal temperature of 23 degree C and still significantly greater at 30 degree C (19.4%) 1 hr after treatment of the leaves. When the RH was doubled, there was a significant increase in the total Cs taken up in the 6-hr period for each of the temperatures considered. Thus, enhanced penetration was obtained by increasing air humidity or leaf moisture content through a decrease in transpiration. Accumulation and transport followed the same pattern and were influenced more by temperature than by humidity. (NSA)

<719>

Levi, H.W., and N. Miekeley, Studies on Ion Diffusion in Vermiculite. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p.

<719> CONT.

161-168) (Hahn-Heitner Institute fuer Kernforschung, Berlin, German Federal Republic)

Clay minerals are an essential part of many soils, and diffusion of radionuclide ions in the crystal lattices of those minerals consequently plays a role in radioactivity migration through soils. Ion mobilities in vermiculite as affected by the phenomenon of fixation are studied mainly by isotopic exchange. Among the radioactive ions showing fixation in vermiculite, cesium is the most important. It is shown that in a Cs saturated vermiculite only the fraction of Cs ions adsorbed at crystal imperfections is exchangeable. For the bulk of Cs no diffusion could be observed even at 100 degrees centigrade over a period of three months. In a vermiculite loaded with traces of Cs, however, these ions do not lose their mobility to this high degree. The behavior of vermiculite loaded with two ions, one of which was Cs, has been examined. In the case of Cs/alkaline earth, the latter was found to remain mobile but to become much slower. This shows that the presence of a non-hydrated and, consequently, fixed ion does not inhibit the migration of other ions in the vermiculite lattice. The conclusion is that it is not lattice-contraction associated with cesium uptake, but rather the state of the particular ion in the lattice that is responsible for the fixation phenomenon. Cesium fixed with respect to isotopic exchange was shown to become mobile by exchange with many other ions. These experiments give evidence of two different defixation mechanisms. Defixation may be caused by strongly hydrated ions as well as by relatively small nonhydrated ions. It is an interesting feature that fixed cesium ions may be exchanged against potassium, but potassium ions remain fixed against cesium. The results presented are discussed with respect to radionuclide migration in soils. (Auth)

<720>

Libby, W.F., Beneficiation of Soils Contaminated with Strontium 90: Beneficial Effects of Potassium. 1958. Science, 128, 1134-1135 (Carnegie Institution of Washington, Geophysical Laboratory, Washington, DC)

Experiments were conducted evaluating the influence of sulfate on plant uptake of strontium from soils. Sulfate did not depress plant uptake of radiostrontium but potassium applications did. (CWF)

<721>

Lieberman, R., and A.A. McWhissey, Co-Precipitation Technique for Alpha Spectroscopic Determination of Uranium, Thorium, and Plutonium. 1968. Health Physics, 15, 359-362 (Southeastern Radiological Health Laboratory, Montgomery, AL)

Use of coprecipitation techniques is described to provide a rapid and routine determination of Th, U, and Pu in environmental samples. The samples investigated included food, vegetation, and soil. The actinides were first separated from each other and from interfering elements by ion exchange methods. Coprecipitants examined included hydroxides, oxalates, and fluorides; of these, hydroxides did not prove satisfactory. Thorium was coprecipitated with lanthanum oxalate with high recoveries. Other coprecipitations studied were: Th and Pu (together) with lanthanum fluoride, and U with lanthanum fluoride. Details of the techniques are

given, including the subsequent alpha spectroscopy. It is emphasized that the La used should be of high purity and free of alpha activity. It is stated that the method is simpler and less costly than the electroplating procedure. (NSA)

<722>

Lisanti, L.E., and U. Marckwordt, Studies on the Enrichment and Distribution of Rubidium in Barley Sprouts. 1963, March. Atompraxis, 9, 92-95 (Landwirtschaftliche Forschungsanstalt, Buntehof, Hanover, German Democratic Republic)

A study was made of the enrichment and distribution of Rb in seven-day-old barley sprouts under the influence of the counter-ions Ca, Mg, and NH₄, as well as mixtures of these. Ca and Mg favored the enrichment of Rb, and NH₄ inhibited it. Distribution of Rb between the shoot and the root was not affected by Ca and Mg. Greater inhibition of enrichment was caused by Rb in the shoot, and by NH₄ in the root. In mixture solutions, the effects of the various counter-ions overlapped. Ca was able to compensate for the negative influence of NH₄, but not for that of Rb. The results obtained are discussed in relation to the carrier theory of nutritional uptake. (Auth)

<723>

Little, J.B., and R.B. McGandy, Systemic Absorption of Polonium 210 Inhaled in Cigarette Smoke. 1968, November. Arch. Environ. Health, 17, 693-696 (Harvard University, Cambridge, MA)

The kinetics of the change in the concentration of Po 210 in the peripheral blood of six cigarette smokers was studied up to 89 days after sudden complete cessation of smoking. Circulating Po 210 levels declined an average of 14 percent after three to four days, and 20.5 percent after 11 to 14 days. The results indicate that a major fraction of the isotope inhaled in cigarette smoke is absorbed directly into the blood stream. (Auth)

<724>

Litver, B.Ya., P.V. Ramzayev, A.A. Moiseev, M.N. Troitskaya, E.M. Krisyuk, E.P. Lisachenko, and A.I. Nizhnikov, Lead 210 and Polonium 210 in Arctic Regions of the Northeast. 1969. A-AC-82/G/L-1293; AEC-tr-7128; Part of USSR Reports on Natural and Fallout Radioactivity, (p. 180-193) (State Committee on Utilization of Atomic Energy, Moscow, USSR)

Concentrations of Pb 210 and Po 210 in various components of the arctic lichen-deer-man food chain were determined in samples taken before and after nuclear testing. Similar quantities of both isotopes were observed in biological samples before and after testing fortifying the theory that insignificant quantities of Pb 210 are generated during nuclear explosions and concentrations of Pb and Po 210 in biological objects are related to natural radioactive fallout patterns of radium 226. (C&F)

<725>

Lomenick, T.F., Movement of Ruthenium in the Bed of White Oak Lake. 1963. Health Physics, 9, 835-845; Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

<725> CONT.

Currently, several thousand curies per year of ruthenium flow into the bed of former White Oak Lake from the ORNL intermediate-level wastes pits. As the waste water traverses the lake bed, a significant portion of the ruthenium is removed from solution. The ruthenium that is not sorbed on the lake-bed soil drains into White Oak Creek, a tributary of the Clinch River. An investigation was made to determine the quantity and distribution of ruthenium in the soil and to identify and define geohydrological factors affecting the movement of ruthenium through the lake bed. As of February 1962, the lake bed contained approximately 1200 curies of ruthenium. The ruthenium is present mainly in two areas or tracts of contamination, covering approximately 10 acres, that coincide roughly with the surface flow of waste over the bed. The highest concentrations of ruthenium occur in the uppermost few inches, and about 10% of the activity found is associated with the top 2 ft of soil. The lake bed is underlain by a thin layer of recent lacustrine sediment, several feet of alluvium, and the Conasauga shale formation of Cambrian age. Water-level measurements indicate that the depth to ground water varies from < 1 ft. to 5 ft below the surface. The subsurface migration of ruthenium follows closely the paths predicted from water-table contours. The rate of ground water movement in the upper 2 ft of soil varies from 1 ft to 5 ft per day, while movement in the material 2 ft to 5 ft below the surface ranges from 0.05 ft to 0.25 ft per day. Thus, the maximum rate of travel of ruthenium in the upper layers of soil is approximately twenty times that of the lower layers. Ruthenium is transported to White Oak Creek by surface water and ground water moving over, through the bed of White Oak Lake. Only a small fraction of the ruthenium is transported by ground water through the lake-bed soil into the creek. The ruthenium moves at such a slow rate through the soil that radioactive decay reduces the concentration of that reaching the creek by subsurface movement to insignificant proportions. The amount of surface flow, and consequently, the quantity of ruthenium that reaches the creek from the lake bed, varies seasonally. During the dry summer months, drainage from the waste pits recharges the ground water in the lake bed. Thus, there is little surface flow and, consequently, little ruthenium that drains into White Oak Creek. However, in the wet winter season surface runoff from the lake bed is high and, therefore, larger amounts of ruthenium enter White Oak Creek. (Auth)

<726>

Lomenick, T.F., and D.A. Gardiner, The Occurrence and Retention of Radionuclides in the Sediments of White Oak Lake. 1965. Health Physics, 11, 567-577 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

As a result of the discharges of large volumes of low-level radioactive liquid wastes to surface streams at the Oak Ridge National Laboratory, large quantities of radionuclides have accumulated in the bottom sediments of White Oak Lake. Ruthenium 106 (1038 Ci) and cesium-137 (704 Ci) account for more than 90 per cent of the total activity now present at the site, while Co 60 (152 Ci), the rare earths (17 Ci exclusive of Y 90), and Sr 90 (15 Ci) make up the remainder. More than half of the activity is associated with the upper 6-in. sediment layer, while progressively smaller quantities of activity are found with depth. The ruthenium, which is restricted to

a small area in the now dry upper lake bed, is partially water soluble; however, its rate of movement through the soil is slow enough so that radioactive decay reduces the concentration of that reaching surface streams to insignificant levels. Most of the Cs 137 occupies highly selective exchange sites on the illitic fraction of the clay in the sediment and can be desorbed only by disruption of the lattice structure. Only a small fraction of the Co 60 in the soil was found to be exchangeable. It is, therefore, unlikely that any large fraction of the Cs 137 or Co 60 would move from the area except through erosion of the sediment. About one-half of the Sr 90 and the rare earths in the sediment appears to be exchangeable, while the other half is in the form of slightly soluble salts. Through leaching by ground water, a slow depletion of strontium from the dry part of the lake bed occurs. The accumulation of radionuclides in the sediments of White Oak Lake illustrates the effectiveness of relatively quiescent bodies of water in concentrating activity in stream beds and in retarding the downstream movement of these materials. (Auth)

<727>

Lomenick, T.F., and T. Tamura, Naturally Occurring Fixation of Cesium 137 on Sediments of Lacustrine Origin. 1965. Soil Science Society of America Proceedings, 29, 383-387 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

White Oak Lake formerly served as a final settling basin for contaminated waste water discharged from the Oak Ridge National Laboratory. The site, which now serves as an ecological study preserve, covers an area of 44 acres and contains approximately 1,000,000 ft³ of contaminated sediment. The most abundant radionuclide present in the sediment of lacustrine origin is Cs 137, 704 plus or minus 35 curies. Concentrations of Cs 137 on the sediment were observed to be as high as 77×10^{-3} uc/g. More than 80 percent of the Cs 137 is associated with the clay fraction of the material, which was found to be predominantly illite. Significant quantities of Cs 137 were removed from the material only by treatment with strong acids. Studies of several selected clays showed illite to have a high affinity for Cs 137 at levels of the same order of magnitude as those observed in lake bed sediment and that desorption is only accomplished after disruption of the lattice structure. (Auth)

<728>

Longhurst, W.M., and R.E. Kepner, Strontium 90 and Cesium 137 Food Chain Relationships to Deer and Sheep. V. Factors Influencing Radionuclide Accumulation, Progress Report, June 15, 1967 - June 16, 1968. 1968, June. UCD-34-P-104-12; 68 p. (University of California, Davis, CA)

Detailed accounts are presented of research progress in the following areas: investigation of, by means of gas chromatography, the volatile compounds in forage plants that are important in determining palatability for deer and sheep; measurement of the effect of fertilization upon the palatability, digestibility, and concentration of various aromatic compounds of Douglas-fir; determination of why new Douglas-fir shoots are more palatable to deer than old-growth needles; determination of deer and sheep preference for seven oak species, as indicated by voluntary consumption; determination of the role of the sensory

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systems in forage selection and voluntary consumption by sheep; confirmation of earlier findings concerning the effect of essential oils from unpalatable plant species on microbial activity; determination of which of the individual oxygenated monoterpenes in bay oil inhibit rumen microbial activity; investigation of the effect of varying dietary regimes on the fermenting capacity of the reticulorumen, cecum, caecum, and anterior colon and on the VFA concentration in the various parts of the alimentary tract. Comparison of the deposition of radioisotopes in tissues of adult deer and sheep, recycling of isotopes (particularly their disappearance from blood and concentration in parotid saliva), transfer of the isotopes across the placenta to fetal tissues, transfer of isotopes through the milk to the nursing young; comparison of Cs 137 accumulation in deer inhabiting chaparral and oak woodland vegetative types; and determination of current Sr 90 levels in yearling deer as a continuation of the long term series dating back to 1950. (NSA)

<729>

Lopatkina, A.P., V.S. Komarov, A.N. Sergeev, and A.G. Andreev, Concentration of Uranium by Living and Dead Peat-Forming Plants. 1970, November. Geochim. Int. (Encl. Transl.), 7, 277-282

Exposed parts of plants, hydromorphic soils, and water from a marshy floodplain of a small stream flowing on mesozoic granites were analyzed for uranium. Water, peat, various mosses, and dead plants from several bogs were also analyzed. It was found that in the humid zone the exposed parts of trees and grasses absorb one tenth to one thousandth of the uranium absorbed by the hydromorphic soil in which they grow, regardless of the concentration of uranium in ground waters. It is concluded that these plants cannot be the source of the high concentrations of uranium in peat. The roots of higher plants, plant debris, and the humus of hydromorphic soils absorb much more uranium if they are in direct contact with water. The lower plants, mosses, etc. absorb considerable amounts of uranium, the amount absorbed depending on the concentration of the element in the ground waters and probably, on the area of contact between plant tissues and water. (NSA)

<730>

Lopes dos Santos, P., E.M. Weinberg, and E. Penna-Franca, Determination of Polonium 210 in Cigarettes and Tobacco. 1970, June-October. Rev. Biol. Med. Nucl. 2, 73-77 (Brazil University, Instituto de Biofisica, Rio de Janeiro, Brazil)

The process of natural fallout resulting from radon emanation from the soil, its decay in the atmosphere, and deposition of its long-lived daughter Pb 210 are the principal mechanisms by which leafy vegetables and tobacco are contaminated by Pb 210. By its decay, Po 210 builds up in the vegetables. The Po 210 contents of tobacco leaves and products were determined. Since Po 210 is volatile at the temperature of a burning cigarette, part of its content in tobacco is inhaled by smokers. Therefore Po 210 may become the principal natural source of irradiation of bronchial epithelium of heavy smokers. Po 210 contents were determined in various tobacco products: cigarettes, cigars, and pipe tobacco of different brands manufactured in Brazil. The average contents of Brazilian cigarettes are about the same as

the values found in the United States, Argentina, India, and Pakistan, above the ones observed in Indonesia, Turkey, and Greece, and below the ones found in Rhodesia, Australia, and Central America countries. (Auth)

<731>

Lopez, P.L., and E.R. Graham, Labile Pool and Plant Uptake of Micronutrients: 1. Determination of Labile Pool of Manganese, Iron, Zinc, Cobalt, and Copper in Deficient Soils by Isotopic Exchange. 1972. Soil Science, 114, 295-299 (University of the Philippines, Manila, Philippines; University of Missouri, Columbia, MO)

A study by isotopic exchange and spectrographic analysis of labile pools of soil samples with demonstrated micronutrient deficiency from Nebraska, Colorado, and Florida revealed the following items of importance: (1) DTPA-CaCl₂-NaAc mixture can be used to estimate the labile pool of Mn, Fe, Zn, Co, and Cu in soils with severe deficiency in these elements. (2) DTPA-CaCl₂-NaAc mixture at pH 5 resulted in higher labile pool of Mn, Fe, and Co, than at pH 6, 7, and 8. (3) With few exceptions, the amount in the solution phase of Mn, Zn, Fe, Co, and Cu approached or equaled the total labile pool of the elements in the soils from Nebraska, Colorado, and Florida. This was not the case in soils from Missouri, which have a much higher level of micronutrients in the labile pool. Lopez and Graham (1970) reported only 47 per cent of the labile pool in the outside solution for Fe, 68 percent in the outside solution for Zn, and 72 percent in the outside solution for Cu, as estimated from the most applicable conditions in the soils. (4) The DTPA extract removes a major proportion of the labile pool, particularly in nutrient-deficient soils. This provides support for use of the DTPA soil test extractant developed by Lindsay and Norvell (1971). (Auth)

<732>

Low, K., and K. Edvarson, Content of Cesium 137 and Zirconium 95-Niobium 95 in Swedish Soils. 1960. Nature, 187, 736-738 (Research Institute of National Defense, Stockholm, Sweden)

The distribution of cesium 137 and zirconium 95-niobium 95 in soils throughout sections of Sweden is presented. (CWF)

<733>

Lucas, J.W., and R. Perry, Cesium 137 in Plant Produce: I. Its Origins and Concentrations in Plants. 1972. Plant Foods and Human Nutrition, 2(3/4), 185-191 (University of Manchester, Radiological Protection Service, Manchester, England)

Cesium 137 is a persistent radionuclide produced in high yield from nuclear fission. The above-ground testing of atomic weapons and especially the major series of tests from 1960-1962 has led to global contamination of the terrestrial environment. The pathways for Cs 137 contamination from its injection into the atmosphere and its transfer to plants used for human food consumption are described and data on a range of plant products from 1960 onwards are presented. Although Cs 137 is accumulating in the upper layers of the soil, the extent of the plant contamination by the root systems is very small and very difficult to distinguish from the contamination arising directly by exposure of the upper parts of plants to contaminated rainwater. Knowledge of the transfer of Cs 137 from soil to plant is very limited but might be important in

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controlling the effects of an emergency should it arise at a nuclear power station. The present levels of Cs 137 in plant produce are considered to present a negligible risk to the future genetic health of the human population. (Auth)

<734>

Ludwig, P., Demonstration and Measurement of Plutonium 239 in Plants. 1962, February. Atompraxis, 8, 57-58 (Biologische Bundesanstalt für Land- und Forstwirtschaft, Berlin-Dahlem, German Federal Republic)

Plutonium, which is present in varying quantities in radioactive fallout from atomic bombs, descends on plants in the form of precipitation or dust. Measurements made in hay samples from 1954 to 1960 showed that Plutonium 239 was present in amounts of up to 5 pc per 100 g. For measuring the Plutonium 239 content, the hay was burned, the ash dissolved, and the plutonium removed with practically no residue. Detailed instructions for determining Plutonium 239 in plant foods, and feedstuffs produced from them are given. (Auth)

<735>

Lyubimova, S.A., N.A. Timofeeva, and N.V. Kulikov, Uptake of Isotopes by Dead Tissues of Freshwater Plants. 1968. Tr. Inst. Ekol. Rast. Zhivotn., 61, 79-82

To the problem of the absorption of radioisotopes by freshwater plants and their role in the processes of migration and distribution of emitters in the components of a reservoir, is added the almost complete lack of data concerning the fate of radioisotopes after the death of the plants and during the formation of detritus. In the present investigation, two examples of higher aquatic plants - bryophyta (DREPAVOCLADUS SEMDNERI) and hornworts (CERATOPHYLLUM DEMERSUM) were studied. The accumulation of four major fission radioisotopes (Sr 90, Ru 106, Cs 137, and Ce 144) by living and dead tissues of freshwater plants, and the extraction of these radioisotopes from living and dead plants back into the environment and repeated accumulation by the living plants were studied. The data indicate that the coefficients of accumulation of Sr 90 for living and dead plants were approximately equal. The coefficients of accumulation of Cs 137 by living and dead hornworts did not differ essentially from each other, but for the bryophyta, the values for living plants were slightly higher than those for the dead tissues. The data, however, for Ru 106 and Ce 144 show that these radioisotopes are accumulated to a greater degree by the dead organic residues than by the living plants. The process of accumulation of the different emitters differed in time. For strontium, equilibrium in the water-biomass system (living and dead) was obtained during the first two days. For cesium and cerium, the coefficients of accumulation increased up to 16 days both for living plants and the dead organic residues. Data concerning the accumulation by the plants of emitters that were received in the water from living and dead vegetable tissues are also presented. The coefficients of accumulation for Sr 90 under all experimental conditions noticeably exceed those for Cs 137. However, the values for each radioisotope were very close in experiments with the addition of emitters to water in the form of chlorides and in the form of the radioactive extracts from the biomass of living and dead

plants. It is believed that Ru 106 and Ce 144, due to the stability of their bonding in the disappearing biomass of plants, will be retained in the bottom deposits and thus be excluded for a certain time from the biological rotation of substances in the reservoir. The radioisotopes of strontium and cesium, on the contrary, are retained in solution and continue to be included in the cycles of biological rotation. (NSA)

<736>

Maerker, R.E., and F.J. Muckenthaler, Gamma-Ray Spectra Arising from Fast-Neutron Interactions in Elements Found in Soils, Concretes, and Structural Materials. 1970, April. ORNL-4475; Nucl. Sci. Eng., 42, 335-351 (Oak Ridge National Laboratory, Oak Ridge, TN)

Experimental data are presented for the production of secondary gamma rays arising from the interaction of a fission-like spectrum of fast neutrons with oxygen, carbon, iron, aluminum, copper, zinc, titanium, nickel, silicon, calcium, potassium, sodium, barium, sulfur, and a stainless steel. Measurements of the gamma-ray spectra for these elements were made at the Tower Shielding Facility with a carefully calibrated 5-in. by 5-in. NaI(Tl) detector. These data are useful in evaluating the accuracy of (n,xgamma) cross section sets. The data are differential in the gamma-ray energy from 1 MeV to approximately 6.5 MeV and are expressed as values of 4 pi times the average differential gamma-ray production cross section at 90 deg to the incident neutron beam for all neutrons in the beam lying above 1 MeV. These results are estimated to have an accuracy of approximately 30 percent and include the contribution from both discrete and continuous gamma rays. Comparisons of these data with results obtained by averaging previously published differential cross sections over the incident spectrum indicate that considerable differences exist between the values obtained at the Tower Shielding Facility and the earlier data. Very approximate experimental data are presented for gamma rays arising from resonance capture of neutrons from a 1/E energy spectrum in the energy range 10 to 200 keV. (Auth)

<737>

Magnaval, R., Vegetable Pollution Through the Soil: Cesium 137. 1973. EUR-5000-f; 23 p. (Commissariat à l'Energie Atomique, Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France)

The measurement of the soil-plant transfer of cesium 137 based on laboratory experiments is compared with the values obtained in situ. These are comparable where the available cesium contents are less than 1%; above this figure the in situ transfer coefficient is less by a factor of two or three. Among the factors influencing indirect contamination, the exchange capacity is mentioned for wheat and the moisture content of the soil and the season for grass. (Auth)

<738>

Major, W.J., R.A. Wessman, R. Melgard, and L. Leventhal, Routine Determination of Plutonium 239 in Fused Soil Lattices by Tracer Techniques. 1965. CONF-650616-33; Part of Proceedings of the Tenth Annual Meeting of the Health Physics Society held in Los Angeles, California, June 1965 (Tracerlab, Technical Services Division, Radiochemistry Department, Richmond, CA)

A precision tracer procedure for the rapid

<738> CONT.

determination of non-uniformly distributed Pu 239 in fused soil matrices up to 50 grams has been developed. Samples consisting of bulk soils or soil particulates collected by various types of coring tools, impactors, filters, tapes, films and trays were assayed for Pu 239 content. The basic steps were dissolution, tracer equilibration, purification, and electrodeposition. The samples were dissolved in HNO₃, HF, and HClO₄ to prepare a stock solution of each sample. This provides for complete solubilization of samples and avoids losses often associated with fusion techniques. An amount of Pu 236 tracer was added either to the dissolution mixture or to a sample aliquot to match, within broad limits, the expected Pu 239 content of the sample. Each solution was treated to ensure equilibration of sample plutonium with the tracer. The plutonium isotopes were then separated from the bulk of matrix elements by extraction into cupferron-chloroform of coprecipitation with Fe(OH)₃ and further purified with anion exchange resins. The purified fraction was electrodeposited on a platinum disc for alpha pulse height analysis. Tracer yield and Pu 239 content were determined from the spectrum. The precision tracer method ensures a high degree of accuracy, high sensitivity and freedom from interference from other alpha emitters. The technique was used successfully for the plutonium assay of over 2600 samples. A typical chemical yield was 70 percent and the counting precision was within 3 percent. Limits of detection were approximately 0.05 dis/min for a thousand minute count. (Auth)

<739>

Makarova, A.I., and T.A. Kozlova, Extraction and Polarographic Determination of Small Amounts of Cobalt in Soils and Plants. 1967. *Agrokhamiya*, 10, 128-131

Co in extracts is concentrated by reaction with beta-nitroso-alpha-naphthol before polarographic determination. (Soils and Fertilizers)

<740>

Makhonina, G.I., Distribution of Various Radioisotopes in Pine Seedlings. 1968. *Tr. Inst. Ekol. Rast. Zhivotn.*, 61, 58-60

The distribution of Co 60, Zn 65, Sr 90, Ru 106, Cd 115, Cs 137, Ce 144, and Hg 203 in pine seedlings was studied in order to determine the concentration of these isotopes in various organs of the plant. The results showed that the higher relative uptake of Sr 90, Zn 65, and Co 60 occurred in the stems and needles of the plant, while the uptake of Ru 106, Cd 115, Ce 144, and Hg 203 was higher in the roots than in the surface parts of the plant. (NSA)

<741>

Makhonina, G.I., and E.A. Gileva, Uptake of Zinc 65, Cadmium 115, and Mercury 203 by Freshwater Plants and Effects of EDTA on the Concentration of these Isotopes. 1968. *Tr. Inst. Ekol. Rast. Zhivotn.*, 61, 72-78

The coefficients of accumulation of Zr 65, Cd 115, and Hg 203 by freshwater plants are very large and are measured by thousands, sometimes by tens of thousands. The addition of these elements to solutions in the form of chelate complexes with EDTA decreases their accumulation by freshwater plants. (tr-Auth)

<742>

Makhonko, K.P., The Deposition of Radioactive Dust and Its Elimination From the Atmosphere by Precipitation. 1969. A-AC-82/G/L-1261; AEC-tr-7128; Part of USSR Reports on Natural and Fallout Radioactivity, (p. 79-111) (Not given)

The general features of the overall pattern of self purification of the lower troposphere from radioactivity are now more or less clear. A number of general tendencies in the process have been established, and the overall parameters of "dry" and "wet" deposition have been evaluated. However, a large number of points still require further clarification. For example, no reliable method exists of measuring overall "dry" deposition, the part played by vertical air currents in the removal of radioactivity from the atmosphere, has hardly been studied and there has been insufficient investigation of scavenging processes. In particular, up to the present most of the theoretical papers on scavenging have dealt with a study of the mechanisms of individual events of particle capture by drops. No complete overall picture of the removal of aerosol materials from the atmosphere has yet been formed on the basis of the separate processes of particle capture by cloud and precipitation drops. Efforts must obviously be made to fill this gap, but experimental investigations frequently deal with the analysis of specific cases of washout taking into account the microphysical parameters of the precipitation. To predict the self purification of the troposphere, it would be useful to have climatological figures for the washout parameters averaged over a wide range, both geographically and in time. In order to use for this purpose the parameters obtained for specific cases or types of precipitation, we must know the duration and frequency of precipitation of these types and the intensity with which they are associated. In spite of the widespread currency of pluviometric observations practically no generalizations of this type have as yet been made. (Auth)

<743>

Makovski, E., Radiometric Method of Seepage Control in Dams and Their Environs. 1967. CONF-661133; STI/PUB-141; Part of Proceedings of a Conference on Isotopes in Hydrology held in Vienna, Austria, November 14-16, 1966, (p. 601-616), 740 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

A problem of current importance in hydrotechnology is seepage and the problems connected with it, such as impermeability of dams and their foundations, the working of narrow mine shafts, etc. Of the many approaches used to investigate these questions, the simplest and most successful is the radiometric method. Radiometric observation of the flow of water in hydrotechnical constructions involves introducing at a fixed point in the flow of water an aqueous radioactive solution, and then following its movement and finding the places where it flows using the appropriate detectors arranged at fixed or variable control points. On the basis of a few years' investigations in field conditions, the means of choosing the injection point, the technique for introducing the radioactive solution into the soil and the conditions that must be borne in mind when selecting the radioisotope and determining its optimum activity are described. The methods of measurement used are also indicated, and a brief description of the equipment is given. Included in the

<743> CONT.

discussion of the choice of injection site is a description of a small probe developed for this purpose: it measures the volumetric weight of the soil, which is used to determine the most suitable injection point, this being the region where the soil is most permeable. The radioisotopes used in the investigations were Cr 51 in the form Na_2CrO_4 , Br 82 in the forms KBr and NH_4Br , I 131 in the forms NaI and KI, Sb 124 in the form SbCl_3 and Au 198 in the form H_2AuCl_4 . Their adsorption values are given for pure sand soils, sand and clay mixtures and rocky soils (granite). The positive results are also given of the investigations carried out in several directions simultaneously using the radioisotopes Br 82, I 131 and Au 198. A short review of the progress of field investigations carried out on several dams in Poland and the results achieved are given. The possibilities which this method affords for the solution of hydrotechnical problems are described. It is used to determine the actual speed and direction of water flow in the section of soil investigated, and also to determine whether an increased flow is of the percolation or the cleft type, the point of origin of increased seepage of hydraulic breakthrough, the cross section of the weakened soil, the depth to which damage to the vertical impermeable screen has occurred and the impermeability of the horizontal screens. (Auth)

<744>

Maksimov, I.N., L.N. Sysoeva, and G.V. Yakovleva, Radiochemical Determination of Specific Activity of Antimony in Different Objects. 1970. Radiokhimiya, 12, 189-191

The use of radiochemical methods for the determination of antimony in external media, such as rocks, clays, soils, vegetation, or water, is demonstrated. The chemical yields of Sb can be determined according to measurement of the gamma-activity before and after radiochemical operations. The determination of specific radioactivity of Sb without dissolution of ground and clay samples requires 6 to 8 hours. The sensitivity of the radiochemical determination of the specific radioactivity of Sb is up to $10(E-10)$ Ci with the content of Sb in the limits of 0.1 gamma and above. (tr-Auth)

<745>

Malysowa, E., J. Bors, and L. Szerszen, Investigations on Profile Distribution of Strontium 90 in Arable Soils of Lower Silesia. 1968. Roczn. Glebozn., 19, 103-112 (College of Agriculture, Wroclaw, Poland)

The migration of Sr 90 in soils under agricultural cultivation in Lower Silesia (Poland) was investigated. Soil profiles were taken, the amount of precipitation measured, and the Sr 90 content in samples was determined. It was concluded that: the surface layer is most highly contaminated in all soils; the depth of Sr 90 contamination depends primarily on the kind of soil, the more clay and silt the greater the contamination; Sr 90 accumulated in the humus horizon of heavy soils; Sr 90 is leached into the depth of the profile of light soils; and the migration of Sr 90 into the soil profile seems to be independent of pH, of the presence of base cations, or of the quantity of organic C present. (NSA)

<746>

Malysowa, E., J. Bors, and L. Szerszen, Strontium 90 Distribution in the Profiles of Some Arable Soils of Lower Silesia. 1967. Roczn. Glebozn., 18, 33-41 (College of Agriculture, Wroclaw, Poland)

Dispersal of Sr 90 was tested in samples of ten soil profiles, taken in 1964 from fields near Wroclaw. They included podzols, pseudopodzols, brown and black earths of various mechanical compositions, and boggy turf soil. Strontium 90 content was determined with the yttrium method of Reissiq, exchangeable Ca of Jensen and Henrikson, and a complete pedologic analysis performed with standard methods. It was found that downward eluviation of Sr 90 in the profile is inconsiderable and is observed in light soils only. The distribution of Sr 90 in the profiles of the tested arable soils is primarily caused by the mechanical soil cultivation. (Auth)

<747>

Malyuga, D.P., A.I. Makarova, and N.N. Makhova, Methods of Concentration and Determination of Cobalt, Nickel, Copper, Zinc, Cadmium, Mercury, and Uranium in Agrochemical, Biochemical, and Biological Investigations. 1967. Agrokimiya, 9, 139-145 (Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

The method for the polarographic determination of Co, Ni, Cu, Zn, and Cd with preliminary co-oxidation of their rubeanic acids was improved. A rapid method for the concentration of U on a sodium diethyl dithiocarbamate base and luminescent determination in soils and plants was developed. The sensitivity of the method is $1.0 \times 10(E-3)\%$ and the precision is 5%. A method for the determination of Hg in humus soil and plants is given. It is based on the sublimation of Hg and extraction titration with dithizone in carbon tetrachloride. Rubeanic acid was used for the concentration of Hg during its determination in plants. (NSA)

<748>

Marckwordt, U., Magnesium-Extractable Cesium in Soils and Cesium Uptake by Plants. 1968. Plant and Soil, 28, 372-374 (Euratom Joint Research Centre, Biology Service, Ispra, Italy)

In the greenhouse experiment ryegrass was grown for five months on widely varying soils that had been artificially contaminated with carrier-free Cs 134. A highly significant correlation was found between Cs 134 uptake by ryegrass and the amount of Cs 134 in the soils that was extractable by $\text{Hg}(\text{NO}_3)_2$ solution. The Cs 134 uptake was not correlated with NH_4 -exchangeable Cs 134. It was considered that Hg can exchange with the Cs ions bound on sites to which access was not limited e.g., by steric hindrance. This exchangeable fraction would thus represent the freely exchangeable Cs of the soil. The high correlation found between Hg -exchangeable Cs and organic matter content was explained by the fact that organic matter was responsible for most of the freely accessible cation-exchange sites in the soil. (Auth)

<749>

Marckwordt, U., and J.J. Lehr, Factors of Transfer of Cesium 137 from Soils to Crops. 1972. EUR-4800; Part of Proceedings of an International Symposium on Radioecology Applied to the Protection of Man and His Environment held in Rome, Italy, September 7, 1971, (p. 1057-1067)

<749> CONF.

(Euratom Joint Research Centre, Ispra, Italy)

In a laboratory investigation, the available Cs 137 in the soil was determined as a function of the contents of clay and organic matter in the soil and expressed as a percentage of the total deposit of Cs 137. Based on the available Cs 137 and a known content of exchangeable potassium in the soil, an estimate was made of the activity absorbed by plants under conditions of ample humidity. The transfer under these conditions of Cs from soil to plant represents an upper limit for the indirect contamination of crops that can be used to define critical levels of contamination by Cs 137 in different soil types. (Auth)

<750>

Marckwordt, U., and J.M. Mousny, Availability of Radiocesium in Relation to Ammonium Fertilization and Potassium Status of Two Soils from Allonville. 1970. CONF-690918-(Vol. 1): Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 571-587), 684 p. (Euratom, Ispra, Italy)

A comparative study was carried out on the availability of Cs 137 in mineral soils, as influenced by varied concentrations of K or NH₄ ions in equilibrium soil solutions. A loess derived parabrown earth and a rendzina both located in Allonville near Amiens were used in this study. The results show that NH₄ ions greatly increase the water solubility of Cs and reduce its fixation by the clay fraction of soil, thus increasing the availability of Cs. The Cs fraction in the soil solution is considerably higher and the fixed Cs lower when the radionuclide is added to soils well supplied with available K. Cs availability decreases with deteriorating K status. By addition of K to the Cs contaminated rendzina, the Cs availability increases only slightly. A K fertilization of the contaminated loess leads to a small increase of Cs in soil solution. The Cs fixation, however, is also higher. As a result, NH₄ and K fertilization both have practical significance as a means to influence indirect Cs contamination of plants on mineral soils. (Auth)

<751>

Marei, A.N., R.M. Barkhudarov, N.J. Novikova, E.V. Petukhova, L.D. Dubova, and V.M. Briqanina, Effect of Natural Factors on Cesium 137 Accumulation in the Bodies of Residents in Some Geographical Regions. 1972. Health Physics, 22, 9-15 (Institute of Biophysics, Ministry of Health, Moscow, USSR; Radiological Laboratory S.E.S. of Gomel District, USSR)

The report contains results obtained at the first stage of an investigation intended to identify regions with high Cs 137 content in the bodies of inhabitants due to stratospheric fallout; to establish distribution curves of accumulation levels of incidence of this isotope in various age groups of the population; and to determine the sources and characteristics of Cs 137 migration to the human body. As a result of observations extending over three years, we determined a territory with an area of more than 100,000 km² where the Cs 137 content in the human body ranges between 10 (E-8) and 10 (E-7) Ci/body. We observed no essential differences in the Cs 137 concentration between children and adults. The main source of Cs 137 in the diet is milk where concentrations of this isotope reach

2000 pCi/l and to a lesser degree it is meat, vegetables and fish. Contamination of these foodstuffs is due to intensive migration of Cs 137 from soil though its concentrations there do not usually exceed those observed in the flat country of middle latitudes in the Northern hemisphere. Increased Cs 137 migration from soil probably results from the structure, mechanical, mineral and chemical composition and acidity of the soil. The constants of Cs 137 transfer from soil to grass increase from 2.5 to 32.6 depending on the type and characteristics of the soil. The object of further investigations will be the mechanism and causality of the increased Cs 137 migration from soil. (Auth)

<752>

Marei, A.N., R.M. Barkhudarov, V.K. Chumak, E.V. Petukhova, E.B. Tyuryukanova, G.A. Kuznetsova, N.Y. Novikova, S.B. Pozhivilova, and G.A. Bogdanovich, Peculiarities of Uptake of Global Cesium 137 and Strontium 90 from Different Food Sources by the Population of Poles'ya. 1970, January. Gig. Sanit., 1, 61-66

Data are presented on the order of passage of Cs 137 and Sr 90 from the soil into food products with due regard for the soil nature and the accumulation of isotopes in the human body. The extent of the passage of Cs 137 from the soil into food products fluctuated considerably and depended on the type of soil. Thus, in a soil consisting mainly of a sand fraction, the passage of Cs 137 was more pronounced. Similar observations were made in respect to all of the objects examined. However, no differences could be detected in the migration of Sr 90. Because of the high passage of Cs 137 into food products, its content in the human body was high as well. (Auth)

<753>

Marfina, K.G., and A.P. Ibraqimov, Radiation Effect on Distribution of Carbon 14 Absorbed During Photosynthesis in Various Groups of Organic Substances. 1968. Uzb. Biol. Zh., 6, 51 (Institute of Experimental Biology of Plants, Tashkent, USSR)

Effects of radiation on distribution of C 14 absorbed during photosynthesis were studied on the basis of data from pre-sowing of gamma-irradiated seeds. It was found that in the labeled carbon dioxide atmosphere the distribution of C 14 was quite varied. Following irradiation of corn leaves and roots, a 222 percent increase of carbon 14 was found in the alcohol fraction of the leaves and a 180 percent increase in that of the roots. The radioactivity of the protein fraction varied slightly, while in the lipid fraction the content of C 14 decreased with increasing radiation doses. In cotton leaves the carbon radioactivity is mainly concentrated in the aqueous and acid fractions. Irradiation resulted in an increase of radioactivity in these fractions as well as in the hydrocarbon fraction, but a decrease occurred in the albumin and lipid fractions. The role of enzymes in radiation effects on photosynthetic reactions is discussed. (NSA)

<754>

Markussen, E.K., Radiochemical Procedures for the Determination of Plutonium in Environmental Samples. 1970. RISO-M-1242; 5 p. (Danish Atomic Energy Commission, Risoe Research Establishment, Roskilde, Denmark)

<754> CONT.

The environmental samples collected during the radioecological studies after the B-52 accident at Thule were analyzed for plutonium according to the procedures given. The solid samples were ashed at 600 degrees Centigrade, and after the addition of carriers and spikes the ash was melted with potassium pyrosulfate to ensure that all plutonium was in a soluble form before the radiochemical analysis which was developed especially for this purpose by a combination of an American ion-exchange procedure and a Danish solvent extraction method. After the radiochemical analysis, which could be accomplished within a day for most types of samples, the samples were counted on silicon surface barrier gamma counters in connection with a multichannel analyser. (Auth)

<755>

Marquardt, W.Z., Influences on Natural Radioactivity in the Layer of Air Near the Ground. 1967. Meteorol., 19, 222-231

Some factors which influence the radioactivity of the near-ground layer of the air are discussed. The annual and diurnal variations of the natural total radioactivity and the diurnal variation of the thoron/Rn ratio are considered. A primary factor is the state of the ground at the observation point. Dry soil provides good soil respiration and, therefore, produces a high rate of contamination of near-ground air. Under moist soil conditions and especially with snow-covered ground there is a marked decrease of contamination. The annual variation of natural radioactivity is modified by the frequency of changes in the various states of the ground. Rapidly rising or fallout atmospheric pressure via soil respiration also affects natural radioactivity: quantitative data can, however, not be detected. Owing to turbulent mixing, contamination of the air decreases with increasing wind velocity, enrichment of Rn and thoron secondary products being prevented, which has been confirmed by special measurements at various heights in Neuglobsow. With maritime air prevailing, lower concentrations are observed than with advection of continental air. Local effects may, however, be superposed. At mountain stations the influence of fog can be demonstrated. It is shown that local and meteorological factors do conspicuously affect contamination. Natural radioactivity may rise above the geologically expected value (e.g., Neuglobsow) or may remarkably decrease below the expected value (e.g., Mt. Brocken, Inselsberg). Measurements of natural radioactivity are not applicable to other places without major errors being introduced. (NSA)

<756>

Marsden, E., Radioactivity of Some Rocks, Soils, Plants, and Bones. 1964. Part of Adams, J.A.S. and Lowder, W.M. (Eds.), Natural Radiation Environment, University of Chicago Press, Chicago, Illinois, (p. 807-824) (Dominion Physical Laboratory, New Zealand)

Observations made primarily in the Pacific Island Nue are summarized. Discussions are included concerning phosphate rocks used in fertilizer, effects of soil and type on gamma activity in wheat, radioactivity of plankton and shell fish, and possible radiation effects on the human population of Nue. (NSA)

<757>

Marsden, E., Some Aspects of the Relationship of Radioactivity to Lung Cancer. 1965. N.Z. Med. J., 64, 367-376 (Not given)

Evidence for association of environmental alpha radiation and incidence of lung cancer is reviewed. There are some indications that polonium may be a factor in lung cancer initiation or development. Experimental evidence reveals that polonium 210 is present in appreciable quantity, i.e., of the order of 0.6 pCi/g in cigarette tobaccos. For an individual smoking two packages of cigarettes a day the radiation dose to bronchial epithelium from polonium inhaled in cigarette smoke is at least seven times that from background sources. Epidemiological or statistical evidence is reviewed. The tobaccos grown on the soils of old granite or granodiorite origin in Rhodesia are particularly radioactive, followed by the tobaccos from somewhat related soils in North Queensland. The New Zealand Motueka tobacco soils are of very low intrinsic activity and the tobaccos grown on them also carry little radioactivity of any sort. Increase in death rates of specific age groups in the United Kingdom since 1910 shows a remarkable correspondence with the figures of increasing importation of Rhodesian tobacco. The rate of increase of lung cancer mortality per 100,000 in New Zealand is much more pronounced than the increase of cigarette smoking per capita. A feasible explanation is that over the previous 20 years the amount of cigarette tobacco leaf grown and used in New Zealand has shown great increase and has replaced much tobacco from the U.S.A., thus reducing the average radioactivity of local cigarettes. However, from 1957 onwards importations of Rhodesian tobacco commenced and increased rapidly to 8% of the total. A comparison of activities indicates this may well have caused the increasing lung cancer figures from 1961. The corresponding figures for Australia show no suggestion of a plateau, but have continued to rise steeply. The use there of Rhodesian tobacco has declined but there has been a steady, more than compensating increase of use of North Queensland very radioactive tobaccos. The relative lung cancer rates for the United Kingdom, Australia, New Zealand, and Canada show a correspondence when per capita consumption is taken into account and the proportions of more radioactive tobacco in the blends. (NSA)

<758>

Martell, E.A., Project Sunshine Bulletin No. 12. 1956. AECU-3297 (University of Chicago, Enrico Fermi Institute for Nuclear Studies, Chicago, IL)

The final report of the Chicago Sunshine Project includes strontium 90 analyses of biological materials, soils, waters, and particles collected by air filters in the Chicago, Ill. area. The strontium 90 in fallout was found to be approximately 95 percent water soluble (CWF)

<759>

Martell, E.A., Atmospheric Aspects of Strontium 90 Fallout. 1959, May. Science, 129, 1197-1206

Mechanisms and models describing radiostrontium atmospheric fallout are presented. Washout by precipitation was found to be the predominant mechanism of fallout. (CWF)

<760>

Harter, W.L., Ground Waste Disposal Practices at the Savannah River Plant. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 95-106) (Savannah River Laboratory, Aiken, SC)

Solid radioactive waste has been buried at the Savannah River Plant since 1953. The waste, consisting of equipment and material contaminated with fission products, activation products, and transuranic isotopes, has been buried in unlined earthen trenches above the water table. A total of 1,500,000 Ci of fission and activation products and 9000 Ci of transuranic elements have been buried through 1966. Materials containing long-lived transuranic isotopes such as Pu 239 are encapsulated in concrete to permit retrieval for more permanent storage. The average cost of all land burial is \$35.00/m³, but burial of transuranic isotopes is higher because of concrete encapsulation. Disposal of high-activity gamma waste is also more costly because of increased handling problems. In thirteen years, no radioactive materials have been detected in ground water underlying the burial trenches, and no significant amounts are expected to outcrop at the surface on the flood plain of a Savannah River tributary. Low-level liquid wastes, mainly from chemical separation areas, are discharged to connected earthen seepage basins. Water level in these basins remains essentially constant because seepage and evaporation are about equal to the volume of rainfall and the influent liquid waste. Liquid wastes are analyzed both before and after disposal in seepage basins. Procedural release guides limit the amount of each isotope discharged because certain long-lived isotopes, such as Sr 90 and Cs 137, could eventually outcrop at a Savannah River tributary. A total of 1500 Ci of fission products (exclusive of tritium) and 13 Ci of transuranic elements have been committed to seepage basins. Only tritium oxide (a ternary fission product) has been detected in a surface stream. This occurred where the seepage basins were close to a stream. The soil surrounding the basins has an ion-exchange capacity that delays the movement of radioactive materials other than tritium oxide. The long travel time to reach a stream, and limits on amounts discharged to the basins, limit the amount of radioactive materials in the off-site environment to levels that will result in exposures far below those set by the Federal Radiation Council. Seepage basins cost about \$0.25/m³ to construct, and experience indicates that the useful life of a basin is greater than 10 years. (Auth)

<761>

Martin, J.R., and J.J. Koranda, Distribution, Residence Time, and Inventory of Tritium in Sedan Crater Ejecta. 1970, November; 1971. UCRL-72572; CONF-701102; Part of Proceedings of the Meeting of the American Nuclear Society held in Washington, DC, November 15-19, 1970, (22 p.); Trans. Amer. Nucl. Soc., 13, 642; Nucl. Technol., 11, 459-465 (Lawrence Radiation Laboratory, Livermore, CA)

The field studies reported enabled the derivation of several important parameters for describing the distribution and fate of a specific radionuclide at the site of the largest nuclear crater produced in the Plowshare program. The distribution and postshot movement of radionuclides in earth materials moved by a nuclear explosive appear

to be one of the formidable problems facing this technology. Because tritium is very likely to be the most mobile radionuclide present in nuclear crater ejecta, its behavior may reasonably describe the upper limits of movement of radioactivity from ejecta. The movement of other radionuclides in Sedan ejecta, especially those scavenged from the gaseous state, such as Cs 137, has been found to occur in a very limited manner. The derivation of tritium half-distance values in the ejecta field of the Sedan crater is a useful descriptive index of spatial distribution of radioactivity. The use of integrated depth profiles to obtain unit surface activity is a technique that will have wide applicability in radioecology. A reasonable upper limit for tritium residence time may be found in the desert ecosystem where the average rainfall is less than 5 inches/yr. The lower limit may be represented by the tropical rainforest where the rainfall exceeds 100 inches/yr. The residence half-time for tritium in the rainforest ecosystem was found to be 29 plus or minus 1 days compared with the value of 400 plus or minus 40 days (13.2 plus or minus 1.3 months) in the desert ecosystem at Sedan crater. It is very significant that the biological tritium residence time in small mammals living at Sedan crater reflected the residence time for tritium measured in the desert soil. The excellent agreement of this independent measurement of the tritium inventory with that previously obtained by a different method attests to the validity of the techniques described. (Auth)

<762>

Martin, R.P., P. Newbould, and R.S. Russell, Discrimination between Strontium and Calcium in Plants and Soils. 1958. Part of Extermann, R.C. (Ed.), Proceedings of an International Conference on Radioisotopes in Scientific Research held in Paris, France, 1957. Pergamon Press, New York, (p. 173-189) (University of Oxford, Department of Agriculture, Oxford, England)

The absorption and distribution of strontium and calcium in barley plants has been studied. The distribution of strontium is similar to that of calcium but it moves more slowly. The observed ratio (i.e. internal Sr/Ca divided by external Sr/Ca) is close to 1 but the values for leaves, which usually contain the major part of the strontium and calcium in herbaceous plants, are normally somewhat lower than those for roots. The stems however show significantly higher values than other tissues. It is concluded that although discrimination occurs between the two ions within plants it is unimportant from the viewpoint of their movement through food chains. The physical characteristics of the labile calcium in soils have been studied by isotopic exchange; rapid and slow exchange reactions have been distinguished. The equilibration of carrier-free strontium 89 and calcium 45 with labile soil calcium is complex; strontium is more firmly retained than calcium. This differential behaviour may increase progressively for periods of at least 70 days. Marked differences occur between soil types and no procedure for extracting strontium and calcium from soils appears adequate to give a valid representation of the relative availability of the two ions to plants. The application of lime increases the labile calcium in soils which is accessible to barley or cabbage. The ratio Sr 89 / Ca 40 absorbed is not correspondingly depressed and in some soils it may be unaffected. These results are compatible with observations that added lime may have little effect on the

<762> CONT.

absorption of radioactive strontium from some types of soil. (Auth)

<763>

Martin, W.E., Losses of Strontium 90, Strontium 89, and Iodine 131 from Fallout-Contaminated Plants. 1964. Radiation Botany, 4, 275-284 (University of California, School of Medicine, Los Angeles, CA)

During the early period following local fallout, and during periods of maximal worldwide fallout, the entry of radionuclides into terrestrial food-chains is due primarily to the external contamination of plants and secondarily to the uptake of radionuclides from contaminated soil. The following studies were undertaken to estimate the rates of radionuclide loss from fallout contaminated vegetation and hence from the diets of herbivores living in a fallout field. On the fifth, fifteenth, thirtieth, and sixtieth days after an underground nuclear explosion (Operation Sedan) at the Nevada Test Site, plant samples were collected from twenty representative locations in the fallout field and analyzed to determine the concentrations (pC/q dry wt) of Sr 90, Sr 89, and I 131 at the times of collection. While the radioactive half-lives of Sr 90, Sr 89, and I 131 are approximately 27.7 years 53 days, and 8.04 days respectively, their average effective half-lives on fallout contaminated plants, during the period from 5 to 30 days after the detonation, were 27.8 days, 17.8 days and 5.0 days respectively. Losses of Sr 90 and Sr 89 were attributed to radioactive decay and to the removal of fallout particles and foliage by wind and/or other mechanical disturbances. Losses of I 131 were attributed to radioactive decay, to mechanical disturbance, and to the vaporization of I 131 from the fallout particles retained on foliage. (Auth)

<764>

Martin, W.E., and F.B. Turner, Transfer of Strontium 89 from Plants to Rabbits in a Fallout Field. 1966. Health Physics, 12, 621-631 (University of California, School of Medicine, Los Angeles, CA)

The objective of this study, which was conducted in the fallout field produced on July 6, 1962, by Project SEDAN, a nuclear cratering experiment at the Nevada Test Site, was to formulate a mathematical model to represent the relationship between gamma dose rates and initial Sr 89 concentrations on fallout-contaminated plants and the time-specific relationship between Sr 89 concentrations on plants and in the bone ash of rabbits collected at the same times and locations in the fallout field. Estimates of gamma dose rates (mR/hr) 24 hr after the detonation were based on the results of aerial radiometric surveys. Estimates of the time-specific concentrations of Sr 89 on plants and in rabbit bone ash were based on analyses of samples collected before and 5, 15, 30 and 60 days after the detonation at twenty representative locations in the SEDAN fallout field. Correlation and regression coefficients based on estimated gamma dose rates and observed Sr 89 concentrations in plant and bone ash samples were highly significant, and analyses of variance indicated no significant deviations from linear regression. The average initial concentrations of Sr 89 on desert shrubs in the SEDAN fallout field were approximately 103 pC/q per mR/hr. The average concentrations of

Sr 89 in plant samples collected 5, 15, 30 and 60 days after the detonation were 1436, 909, 544 and 313 pC/q respectively, indicating an effective half-life of 18 days from D+5 to D+30 and of 38 days from D+30 to D+60. The average concentrations of Sr 89 in rabbit bone ash samples collected 5, 15, 30 and 60 days after the detonation were 863, 1680, 2097 and 1389 pC/q respectively. Estimates based on the 18-day effective half-life of Sr 89 on plants indicated an effective half-life of about 20 days for Sr 89 in rabbit skeletons. Rabbits were assumed to eat 2 g of dry plant material per q bone ash/day, and the average concentrations of Sr 89 in rabbit diets were assumed to be the same as the average concentrations in plant samples collected at the same times and locations in the fallout field. Estimates based on these assumptions and on the observed concentrations of Sr 89 in bone ash suggested that only 5.75 percent of the Sr 89 ingested was assimilated and deposited in rabbit bone. An exponential model based on the parameters described above was tested and found to provide a reasonable representation of the time-specific relationship between Sr 89 concentrations on fallout-contaminated plants and in rabbit bone ash. Using the same model to estimate the infinity doses delivered by Sr 89 to rabbit bone indicated a range from about 0.1 to 9.5 rad and an average of 1.12 plus or minus 0.36 rad in areas 12-110 miles from ground zero. Estimates of integrated doses indicated that 93 percent of the infinity dose was delivered during the first 120 days after the detonation. (Auth)

<765>

Mason, B.J., Selective Inhibition of Ion Absorption by Uranyl. 1967. Ph.D. Thesis (Oregon State University, Corvallis, OR)

The effects of uranyl (UO₂+2) upon the absorption of Li, Na, K, Rb, and Cs were evaluated. Owing to the biological importance of Na and K, these two ions were studied in the greatest detail. The results showed that, at UO₂(+2) concentrations above 1 x 10⁻⁴ (E-1) milliequivalents per liter and pH's above 4.5, uranyl selectively inhibited K and Rb absorption but had essentially no effect upon Na and Li. Under these same conditions it was concluded that uranyl polymers such as (UO₂)₃(OH)₄(+2) were formed. It was suggested that these polymers produced the inhibition of K and Rb absorption. The results of this study suggest that there are at least two carriers transporting Na and K. One of these carriers was inhibited by the higher uranyl concentrations at pH's above 4.5. This carrier shows a preference for K. The second carrier was unaffected by UO₂(+2) and showed a preference for Na. When only one of this pair of ions was present it could travel via either of the carriers. Competition of K with Na was greatest during absorption via the (+2) sensitive carrier. Na competition with K was greatest during transport via the UO₂(+2) resistant carrier. It is suggested that UO₂(+2) may bind to a phosphate containing organic compound which is either the K carrier or a compound closely related to this carrier. (NSA)

<766>

Mason, B.J., W.J. Wipper, and V.D. Leavitt, Tritium Uptake Following a Thermonuclear Test. 1969. STI/PUB-226; CONF-690317; Part of Proceedings of a Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials held in Vienna, Austria, March 24-28, 1969, (p. 167-174)

<766> CONT.

(U.S. Public Health Service, Las Vegas, NV)

The mission of the Agricoq Section of the U.S. Public Health Service's Southwestern Radiological Health Laboratory is to develop radiation dose prediction models for components of man's food web that are likely to be affected by radioactivity resulting from the peaceful uses of nuclear explosives. At the Nevada Test Site this section has developed a farming facility which is located approximately two miles downwind from the nuclear crater resulting from the July 1962 detonation of the 100 kiloton thermonuclear device, Project Sedan. This report presents results of a study to evaluate the uptake of tritium by selected crops that are important to Nevada's agricultural economy. To determine the distribution of tritium from this detonation, a four-station transect was located along the axis from the Sedan crater to the farm facility. A graph of the 1968 tritium profile in the soil indicates a maximum concentration at a depth of approximately 70 cm. This depth is closely correlated with the depth of the maximum desert rainfall penetration for this area. Prior to cultivation, the tritium concentration in the soil surface plow layer of the farm ranged from 11.4 to 26.5 pCi/ml of soil water or 0.21 to 0.42 pCi/g of dry soil. Comparisons made between radishes (*RAPHANUS SATIVUS*), potatoes (*SOLANUM TUBEROSUM*), sweet corn (*ZEA MAYS*), bush beans (*PHASEOLUS VULGARIS*), watermelons (*CITRULUS VULGARIS*), and onions (*ALLIUM CEPA*) grown on the Nevada Test Site farm and similar produce purchased in the local markets indicated a significant difference between the tritium concentrations at the 99 1/2 percent confidence level. Many of the items purchased in the local markets were below the minimum sensitivity of the analytical system used in this study. The levels in the Nevada Test Site crops ranged from 2.0 to 3.0 pCi/g of dry tissue, or 3.00 to 4.87 pCi/m of tissue water. Although the concentrations found are of little significance as far as total dose to humans is concerned, this study has indicated that tritium is available over considerable periods of time and does not leave the environment via evaporation as has been suggested. (Auth)

<767>

Masuda, K., and T. Yamamoto, Studies on Environmental Contamination by Uranium. II. Adsorption of Uranium on Soil and its Desorption. 1971. J. Radiat. Res., 12, 94-99 (Hygienic Laboratory, Okayama Prefecture, Japan)

Experimental studies on the behavior of uranium on soils were carried out using three kinds of soil: volcanic ash, alluvial, and sandy soils. The results showed that uranium dissolved in water (1 to 100 ug as U/ml) was almost completely adsorbed on every soil examined. The desorption of uranium from soil with salt solutions was extremely difficult especially from volcanic ash soil. (Auth)

<768>

Matsumura, T., and T. Ishiyama, Adsorption of Radioactive Materials by Coal Humic Acid. 1966. Annu. Rep. Radiat. Center Osaka Prefect., 7, 14-17

The adsorptive properties of coal humic acid, which was extracted from oxidized coal, were investigated in a batch system using test liquids containing Cs 137-Ba 137, Sr 89, and Co 60. The performance of the humic acid as an ion exchanger was considerably improved by changing it into the Na-form by pretreatment

with NaCl solution. The distribution coefficients were higher for Sr 89 and Co 60 than for Cs 137-Ba 137 and took satisfactorily high values at the pH range between 4 and 7. The distribution coefficients decreased with increases in competing Na or Ca ion concentration; in the presence of Ca ions of considerably high concentration, the distribution coefficient was higher for Cs 137-Ba 137 than for Sr 89 and Co 60. (Auth)

<769>

Mattsson, L.J.S., and R.B.R. Persson, Radioecology of Sodium 22, Polonium 210, and Lead 210 in the Unique Foodchain: Lichen-Reindeer-Mar. 1972. EUR-4800; Part of Proceedings of an International Symposium on Radioecology Applied to the Protection of Man and His Environment held in Rome, Italy, September 7, 1971, (p. 1135-1151) (University of Lund, Lund, Sweden)

The lichen-reindeer man food-chain was studied for several years as a model system for obtaining information on factors of transfer for radionuclides from deposition to reindeer diet and from reindeer diet to man. Sodium 22, which is naturally produced in the atmosphere, was also introduced there in relatively large amounts by thermonuclear detonations in 1961 and 1962. The main source of Pb 210 in the atmosphere is naturally-produced Rn 222, which is exhaled from the ground. The Na 22-, Pb 210- and Po 210-contents of lichen-carpet (CLADONIA ALPESTRIS), reindeer-tissues, and human blood were investigated during the period from 1961 to 1970. The radioactivity concentration of Na 22 in reindeer flesh rose rapidly from about 1 to 10 pCi/kg to a maximum value of 200 pCi/kg wet weight in late 1964. A mathematical model describing the Na 22-transport from reindeer-blood to -bone is given. The Pb 210-activity concentration found in different tissues of reindeer slaughtered in March 1970 and 1971 varied from 3100 pCi/kg wet weight in bone to 12 pCi/kg wet weight in meat. Blood samples from Lapps engaged in reindeer breeding were also analyzed. (Auth)

<770>

Mayberry, B.D., Differential Absorption of Strontium by Plants, Final Report. 1966. TID-23052; 19p. (Tuskegee Institute, Tuskegee, Alabama)

The factors which influence the accumulation of strontium in edible plant parts were studied. Lima beans, squash, potatoes, and tomatoes were grown in the greenhouse and in the growth chamber. The growing medium was Norfolk loamy sand of low (5.7) initial pH. Plant nutrients, other than calcium, were added in calculated optimum amounts. Calcium was added to the potted soil at the calcium carbonate equivalent of 0, 405, 810, and 1350 pounds/acre. The plants were grown under these conditions to the stage of harvest for commercial purposes. Analysis and evaluation of results involved the use of isotopic techniques, with Sr 89 used as the indicator. The practice of succession cropping did not significantly decrease strontium absorption, since the amount of strontium uptake by each crop was a very small fraction of the total dose and had no effect on the uptake by successive crops. The uptake of strontium by plants, irrespective of species, was decreased with increase in calcium content of the acid soil up to the point of 100 percent of base saturation. The total uptake of strontium by plants differed with the species. (NSA)

<771>

McFarlane, J.C., and B.J. Mason, Plant Radiiodine Relationships: A Review. 1970. SWRHL-90-r; 53 p. (Southwestern Radiological Health Laboratory, Las Vegas, NV)

This review surveys the literature germane to the entry of iodine into plants, either through foliar absorption or uptake through roots. Factors affecting the availability to plants by either mode is dependent upon iodine concentration gradients, pH, plant species, and general environmental chemistry of iodine. The large variability in methods of reporting plant iodine concentrations; such as, wet weight, leaf area and ground area covered by plants, has made it difficult to compare radiiodine concentrations from one study to another. Expression of iodine concentrations in plants on the dry weight basis is considered preferable. (CWF)

<772>

McHenry, J.R., Ion Exchange Properties of Strontium in a Calcareous Soil. 1958. Soil Science Society of America Proceedings, 22, 514-518 (Hanford Laboratories Operation, Richland, WA)

The exchange of strontium ion for calcium of the soil complex was found to be a function of the initial strontium concentration, the pH of the equilibrium system, and the nature and concentration of the complementary ions. The ratio of the exchangeable strontium per gram of soil to that unadsorbed per milliliter of solution was constant when the strontium-ion concentration was less than 10 E-5M. The presence of other cations had little effect on the exchange of strontium when the initial strontium-ion concentration was less than 10 E-6M. The exchange of strontium is particularly sensitive to pH-being maximum between pH 8 and 10 and decreasing rapidly as the pH is lowered below 8.0. Strontium exchanged on a calcareous soil may be replaced by various cations by extensive leaching. Hydrogen ions readily replace strontium. The effectiveness of other cations is a function of their concentration, charge, and thermodynamic activity. Large volumes of solution containing radiostromium are decontaminated on passing through a unit volume of the calcareous soil employed in this study. Such a soil is capable of concentrating 0.5 mc. of Sr 90 per g. of soil when the percolating solution contains less than 10 E-6 moles per liter of strontium. (Auth)

<773>

McHenry, J.R., Use of Tracer Technique in Soil Erosion Research. 1969, Spring. Isotop. Radiat. Technol., 6, 280-287 (U.S. Department of Agriculture, Sedimentation Laboratory, Oxford, MS)

Techniques used to study erosion by tagging soil with radioactive tracers are reviewed. Several nuclides have been used for this purpose, e.g., Fe 59, Sc 46, Au 198, and Cr 51. Guidelines to be followed in the selection of a tracer are reviewed, and methods of incorporating the isotope on the material to be traced are described. Studies are discussed in which both the movement of single grains of sand and the bulk movement of the soil are followed. (Auth)

<774>

McLaren, A.D., Radiation as a Technique in Soil Biology and Biochemistry. 1969. Soil Biol. Biochem., 1, 63-73 (University of California,

Berkeley, CA)

A history of the utilization of ionizing radiation in soil science is presented, beginning with observations on the difference in sensitivities of various genera of soil organisms to radiation sterilization and on residual enzyme activities in sterile soil. As a rule, the larger the microbe, the smaller is the minimum dose required. Generally, microorganisms and enzymes are killed or inactivated as exponential functions of dose of radiation, but the dose requirements depend upon the soil type, soil moisture and genus of organism. Irradiation induces release of small amounts of manganese, ammonium, soluble carbon, organic nitrogen, phosphorus, etc., from soil microbes and, to a lesser extent, from humus. The nutrients released can stimulate plant growth in radiation-sterilized soil: no toxicity has been noted following soil irradiation. Cells no longer able to proliferate after irradiation may still be biochemically active, e.g., in respiration and nitrification. Irradiated soil is useful for studies of plant-soil-microbe relations in cases where residues from chemical sterilizing reagents or toxic products from steam sterilization treatment are to be avoided. (Auth)

<775>

McLean, E.O., T.G. Arscott, and V.V. Volk, Adsorption and Release of Strontium from Clays and Soils with Equilibration, Isotopic Tracer and Plant Uptake Techniques. 1960. Soil Science Society of America Proceedings, 24, 435-457 (Ohio Agricultural Experiment Station, Wooster, OH)

The percentages of Sr 90 adsorbed by bentonite and illite clays when saturated to various degrees with the complementary ions H, Ca, Ba, and K were determined. The percentages of Sr 90 taken up in an 8-hour period by soybean plants from the above systems as well as from solutions containing the same total concentrations of the cations as the clays were also computed. The amounts of Sr absorbed by a soil containing various levels of exchangeable Ca (established by prior rates of liming in the field) were measured by equilibration with SrCl2 solutions. Sr was generally absorbed less and taken up by plants more from illite than from bentonite. Addition of Ca or Ba as compared to H decreased Sr adsorbed and increased Sr uptake by plants from the clays, thus having the effect of accelerating the decontamination of the clays by cropping. Sr appeared to be bonded by bentonite but not by illite with sufficient energy to restrict its uptake by soybeans. Increased level of exchangeable Ca in a soil did not appreciably affect the amounts of Sr adsorbed from SrCl2 solutions. (Auth)

<776>

McLean, E.O., C. Lakshmanan, and F.P. Miller, Relative Adsorption and Desorption of Strontium and Calcium to and From Soils and Soil Clays: Column Saturation-Displacement and Acid Displacement. 1969. Soil Science, 107, 206-212 (Ohio State University, Columbus, OH; Ohio Agricultural Research and Development Center, Wooster, OH)

Selective adsorption of Ca and Sr to various soils was determined by means of column saturation-displacement technique. The leaching experiments showed marked preferential adsorption of calcium in the Ap horizon with small preferential strontium adsorption in B horizon and approximately

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equal adsorption in the C horizon. (CWF)

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Mel'nikova, M.K., and Z.A. Baranova, The Mechanism of Radiostrontium Intake in Potato Tubers. 1969. A-AC-82/G/L-1288; AEC-tr-7128; Part of USSR Reports on Natural and Fallout Radioactivity, (p. 127-142) (State Committee on Utilization of Atomic Energy, Moscow, USSR)

Potatoes grown at temperatures between 1 and 35 C revealed no significant increase in strontium adsorption by the tubers indicating strontium uptake in the tubers to be a nonmetabolic process. Concentrations of strontium and calcium in the potato tuber could be explained by solutions of the Fick diffusion equation suggesting that strontium and calcium entry in the tubers was a result of direct contact of the tubers with soil containing these elements. (CWF)

<778>
Mel'nikova, M.K., and Z.A. Baranova, On the Mechanism of Calcium and Strontium Uptake (on the Example of Radiocalcium and Radiostrontium) by Potato Tubers. 1967. CONF-660405; Part of Aberc, B. and Hunsate, P.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966, Pergamon Press, Oxford, England, (p. 409-413), 1051p. (The Agronomical Institute, Leningrad, USSR)

Diffusion of calcium and strontium from the soil into the potato tuber was advocated as the chief method of entry rather than uptake through the root system. (CWF)

<779>
Mel'nikova, M.K., and A.D. Kudelya, Reaction in Soil of Traces of Strontium with Alkaline Metal Phosphates and Strontium Uptake by Plants. 1966. Radioaktiv. Pochv. Metody Opred., Akad. Nauk SSSR, 133-154

Adding phosphates equivalent to the exchange capacity of the soil converted 70 percent of the exchangeable Sr at pH greater than and approximately 6 into non-exchangeable form. A decrease in pH was followed by gradual entry of Sr into the soil solution. The presence of H⁺ and Fe in the soil resulted in the formation of non-exchangeable Sr. Addition of alkaline metal phosphates to the soil equivalent to its exchange capacity decreased the amount of Sr absorbed by plants by 10 percent. (Auth)

<780>
Mel'nikova, M.K., V.M. Prokhorov, and Z.A. Baranova, Diffusion of Calcium 45 and Strontium 90 in Potato Tubers as in a Two-layer System. Soviet Plant Physiology, 18(5), 839-844

Starting from our previous finding that calcium and strontium enter potato tubers from the soil mainly by diffusion when the tubers are in immediate contact with the soil, we measured the rates of calcium and strontium diffusion in the tubers. It was found that with respect to mobility of calcium and strontium the tubers represent a two-layer system, consisting of the outer skin and the flesh, throughout their development. As the usual method of solving the diffusion equation is inapplicable to such a system we evolved special formulas, constructed a numerical table for the calculations, and devised a method of finding the coefficients of ion

diffusion in two-layer systems. We calculated the numerical values of the coefficients of diffusion of calcium 45 and strontium 90 by that method, and found that they were different for the skin and the flesh; they depended on the age of the tuber and they were of the order of from 10 (E-10) to 10 (E-7) cm²/sec. The Ca(+2) and Sr(+2) ions diffused in the tubers at practically the same rate. (Auth)

<781>
Menzel, R.G., Soil-Plant Relationships of Radioactive Elements. 1965. Health Physics, 11, 1325-1332 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Soils Laboratory, Beltsville, MD)

The plant concentration of various radioactive elements, after they have been added to soils in water-soluble forms, may be several orders of magnitude higher or lower than the concentration in the soil. Those that are most readily absorbed are soluble in the soil or are isotopic with elements that have metabolic functions in the plant. Those that are least absorbed are quite insoluble in the soil. The gamma radiation doses to plants would come predominantly from the soil, as would the beta radiation doses except for the beta radiation from those few elements which may be highly concentrated in certain plant tissues. The role of plants in movement of radionuclides in soil is minor except over very long periods of time. (Auth)

<782>
Menzel, R.G., Airborne Radionuclides and Plants. 1967. CONF-661217; Part of Proceedings of a Symposium on Agriculture and the Quality of our Environment held in Washington, DC, December 26-31, 1966, (p. 57-75); Publ. Amer. Ass. Advan. Sci., 85, 57-75 (U.S. Department of Agriculture, Soils Laboratory, Beltsville, MD)

Current information on the factors governing the deposition of radioactive materials from the air and their retention by plants is reviewed and summarized. Consideration is given to the effects of background radiation on the evaluation of hazards from radioactive fallout in the environment, the nature of airborne radioisotopes, mechanisms of radioisotope deposition, mechanisms and factors affecting radioisotope retention by plants, and the effects of radioisotope contamination on the plant. (NSA)

<783>
Menzel, R.G., Uranium, Radium, and Thorium Content in Phosphate Rocks and Their Possible Radiation Hazard. 1968. J. Agr. Food Chem., 16, 231-234 (U.S. Department of Agriculture, Beltsville, MD)

A survey of phosphate rock samples from all major phosphate producing areas of the world showed that phosphate rocks from Florida, the main source of fertilizer phosphates in the United States, ranked relatively high in content of uranium, radium, and thorium. In areas where crops are fertilized with high rates of phosphate from Florida, the addition of uranium and radium may equal the amounts occurring naturally in the plow layer of soils, but the addition of thorium would be less than the amount occurring naturally. The radiation hazard, which might result from uptake of radium into food plants, appears to be negligible. (Auth)

<784>

Menzel, R.G., Land Surface Erosion and Rainfall as Sources of Strontium 90 in Streams. 1974. Journal of Environmental Quality, 3, 219-223 (U.S. Department of Agriculture, Agricultural Research Service, Water Quality Management Laboratory, Durant, OK)

Strontium 90 concentrations in streams from 1958 to 1967 reflected the changing concentrations in rainfall and accumulation on the land surface. Correlation analysis of data from nationwide sampling networks shows that the Sr 90 concentration in streams was accounted for, on the average, by 1.7% of the rainfall 2 months earlier, and annual erosion of 0.58% of the accumulated Sr 90 on the land surface. Direct runoff of Sr 90 in preceding rainfall was highest, 2.0 to 2.2% in the north central and eastern United States, ranging down to no measurable direct runoff in the southwestern United States. Annual erosion of Sr 90 from the land surface ranged from 0.75% in the Ohio River Basin to 0.17% in the Missouri River Basin. If one allows for differences in time and area of application, these results for land surface erosion indicate the potential movement of persistent, strongly adsorbed pesticides from large land areas. (Auth)

<785>

Menzel, R.G., Transport of Strontium 90 in Runoff. 1960. Science, 131, 499-500 (U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD)

Only a small portion of the strontium 90 that fell on cultivated soils was removed in runoff. The concentration of strontium 90 was usually about 10 times higher in the soil carried by the runoff than in the soil from the plow layer of the plots. Thus, a considerable concentration of Sr 90 could occur in areas where runoff sediments accumulate. (Auth)

<786>

Menzel, R.G., Competitive Uptake by Plants of Potassium, Rubidium, Cesium, and Calcium, Strontium, Barium from Soils. 1954. Soil Science, 77, 419-425 (U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD)

Radioactive isotopes were used to follow the uptake by plants of tracer quantities of the heavier alkali and alkali earth ions applied to soils. The uptake of strontium and barium was inversely proportional to the exchangeable soil calcium, and the uptake of rubidium and cesium was inversely proportional to the available soil potassium. Distribution factors for uptake of the alkali ions were calculated as percentage of applied ion taken up over percentage of available potassium taken up. For the alkaline earth ions the denominator was the percentage of exchangeable calcium taken up. Distribution factors were: rubidium, 1.0; cesium, 0.04 strontium, 0.4 and barium, 0.02. (Auth)

<787>

Menzel, R.G., H.V. Eck, and D.F. Champion, Effect of Placement Depth and Root-Inhibiting Chemicals on Uptake of Strontium 85 by Field Crops. 1967. Agronomy Journal, 59, 70-72 (Texas A&M University, Agricultural Experiment Station, College Station, TX)

Uptake of strontium 85 was sharply reduced by burying it deeply enough in the soil or by

burying it in contact with chemicals that inhibited root development in the contaminated zone. With soybeans grown at Beltsville, Md., uptake of strontium 85 from 75 cm below the soil surface was only 1 percent of that from the surface 15 cm. But with sorghum grown at Bushland, Texas, uptake from 100 cm was 40 percent of that from the surface 15 cm. Application of sodium carbonate with strontium 85 at 50 cm reduced uptake by both crops to only a few percent of that from the same depth when no chemical was used. (Auth)

<788>

Menzel, R.G., H.V. Eck, P.E. James, and D.E. Wilkins, Reduction of Strontium 85 in Field Crops by Deep Plowing and Sodium Carbonate Application. 1968, September-October. Agronomy Journal, 60, 499-502 (U.S. Department of Agriculture, Soils Laboratory, Beltsville, MD)

Deep plowing reduced uptake of Sr 85 by four irrigated crops on Pullman silty clay loam at Bushland, Texas. Uptake was further reduced when Na₂CO₃ was plowed under with the Sr 85. The relative concentrations of Sr 85 in mature soybean (GLYCINE MAX), sugar beet (BETA VULGARIS), sudangrass (SORGHUM SUDANENSE), and cabbage (BRASSICA OLERACEA var CAPITATA) plants grown with Sr 85 applied in different treatments were: rotary tilled 20 cm deep, 100; plowed 90 cm deep, 25-50; plowed 90 cm deep with 22,400 Kg/ha (10 tons/acre) of Na₂CO₃, 3-7. In the plowing treatment, 90 percent of both the Sr 85 and the Na₂CO₃ was banded in the plowing and were affected very little by the application of Na₂CO₃. This experiment demonstrates that a toxic chemical can be plowed under deeply with radioactive contamination to reduce the uptake of the radioactive material with little effect on yield from the chemical. (Auth)

<789>

Menzel, R.G., and W.R. Heald, Strontium and Calcium Contents of Crop Plants in Relation to Exchangeable Strontium and Calcium of the Soil. 1959. Soil Science Society of America Proceedings, 23, 110-112 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Eastern Soil and Water Management Research Branch, Beltsville, MD)

The relative uptakes of Sr and Ca were determined for crops grown in the field and greenhouse. Exchangeable Sr and Ca contents were determined in 93 plow layer samples representing 51 soil types in 11 widely scattered states. The average ratio was 1.3, with a range of 0.2 to 4.0, Sr atoms per 1,000 Ca atoms. The ratio varied more according to area than according to type of parent rock, and was similar to the ratio in surface water supplies. The ratios of Sr and Ca in alfalfa or wheat grown in the field were nearly equal to those in the exchangeable cations of the soil. Ten species of cultivated plants grown on 4 soils in the greenhouse had Sr and Ca ratios averaging 0.7 times those of the exchangeable cations in the soils. Small, but statistically significant, differences in relative Sr and Ca uptakes were found with different crops and soils. (Auth)

<790>

Menzel, R.G., and W.R. Heald, Distribution of Potassium, Rubidium, Cesium, Calcium, and Strontium with Plants Grown in Nutrient Solutions. 1955. Soil Science, 80, 287-293 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation

<790> CONT.

Research Division, Beltsville, MD)

Radioisotopes have been used to measure the relative uptakes of certain heavy elements and chemically similar essential nutrient elements. Rubidium tended to concentrate in the flowers and young leaves of the test plants and in the roots of all except buckwheat. Cesium was absorbed only 0.2 times as rapidly as potassium, but otherwise was distributed similarly to rubidium. Strontium and calcium were absorbed in a ratio 1:1 times the ratio of their concentrations in the nutrient solutions, but strontium was concentrated in the roots, and the strontium to calcium ratio became progressively lower in the stems, petioles, and leaves. (Auth)

<791>

Menzel, R.G., and P.E. James, Treatments for Farmland Contaminated with Radioactive Material. 1971. TID-25845; 18 p. (U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD)

This article is a review of the literature regarding possible methods for decontaminating agricultural farmland. Various treatments are considered, such as removal of surface soil, deep tillage and applications of lime, fertilizer and other amendments which may reduce entry of radionuclides from soils into crops. Each contaminating event should be carefully evaluated in respect to the feasibility of such treatments. Alternates to treating contaminated soil are suggested, such as removal of the radionuclide from foodstuffs and careful management of selected crops on selected contaminated soils. (CWF)

<792>

Menzel, R.G., D.L. Myhre, and H. Roberts, Jr., Foliar Retention of Strontium 90 by Wheat. 1961. Science, 134, 559-560 (U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD)

Wheat harvested from the University of Maryland Agronomy Farm in June 1959 contained 20 to 50 micro-microcuries of strontium 90 per kilogram of grain. More than 90 percent of the strontium 90 came from deposition on above ground plant parts, and less than 10 percent was taken up through the soil. About 1 to 2 percent of the strontium 90 fallout during the time the heads were exposed was retained in the grain. (Auth)

<793>

Menzel, R.G., H. Roberts, Jr., E.H. Stewart, and A.J. MacKenzie, Strontium 90 Accumulation on Plant Foliage During Rainfall. 1963. Science, 142, 576-577 (U.S. Department of Agriculture, Agricultural Research Service, Soils Laboratory, Beltsville, MD; U.S. Department of Agriculture, Agricultural Research Service, Florida Agricultural Experimental Station, Fort Lauderdale, FL; U.S. Department of Agriculture, Agricultural Research Service, Southwestern Irrigation Field Station, Brawley, CA)

Accumulation of Sr 90 in field-grown crops was measured during the spring of 1962. Each rainfall markedly increased the Sr 90 content of the crops, except when the plants were very small. Accumulation between rains was comparatively small, about equal to the expected uptake from the soil. (Auth)

<794>

Mercer, B.W., A.J. Shuckrow, and L.L. Ames, Jr., Fixation of Radioactive Wastes in Soil and Salt Cakes with Organic Polymers. 1971. BNWL-1220; 47 p. (Battelle Memorial Institute Pacific, Northwest Laboratories, Richland, WA)

Organic polymers of the type used in fiberglass laminates were evaluated for use in the fixation of radioactivity in soil and preformed salt cakes. In situ fixation of the radioactivity is to be accomplished by injection of the polymers into soil or preformed salt cakes. This approach circumvents the costs and hazards associated with the alternate method of excavating the highly radioactive soil or salt for processing or burial. The results of laboratory studies show that water leach rates of radioisotopes or ions from the soil and salt cakes were reduced by 99.9% or more by incorporation of the soil or salt in a suitable resin matrix. Injection of catalyzed liquid resin into soil with subsequent polymerization to form a hard mixture was demonstrated in both laboratory and field experiments. (Auth)

<795>

Mercer, E.E., The Chemistry of Ruthenium Complexes. 1972. SR0-676-1; 12 p. (University of South Carolina, Columbia, SC)

Nitrosylruthenium complexes which are thought to be the main form in which Ru moves through soil from waste disposal areas were investigated using infrared and Raman studies. This work, although of great interest to basic chemists, is not particularly useful in delineating forms and reaction products of these complexes in soils. (CWF)

<796>

Mercer, E.E., and F.B. Ellis, Downward Movement of Strontium 90 and Cesium 137 in Soil. 1964. ARCRL-12; (p. 49-51) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

The measurement of fallout Sr 90 and Cs 137 in soil profiles of permanent pastures was investigated from 1961-1963. The sites included flat permanent pastures, areas with run-off and run-on, and moorland areas. As in previous years the major fraction of the total deposit remained near the soil surface. A higher fraction of the total deposit in the surface horizon of the moorland sites may be attributable to the relatively high content of organic matter. (ST)

<797>

Merritt, W.F., and C.A. Hawson, Experiences with Ground Disposal at Chalk River. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 79-92) (Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada)

The soil at Chalk River is quite shallow and consists mainly of sand. It has a low exchange capacity, but is very permeable. Large disposals of radioactive wastes have been made into this soil, in solid and liquid form, both experimentally and as part of the normal waste management program. The experiments included the pumping of kilocurie amounts of mixed fission products, dissolved in nitric acid, into soil pits. An emergency disposal of mixed fission products suspended and dissolved in water, resulting from a reactor accident,

<797> CONT.

was also made directly into the sand. The geology and soil structure are known in considerable detail, and the hydrology of the region around the waste management areas have been studied intensively. A description is given of the rate and direction of movement of radionuclides through the soil, and particularly in the ground water. It will be shown that, even under the difficult conditions at Chalk River, direct disposal into the ground has been both convenient and safe. The amount of ground used has been small, and movement of radionuclides through the soil has been extremely limited. Decay of radionuclides during their slow movement makes ground disposal a safe operation if ground conditions are adequately known. (Auth)

<798>

Meyer, M.W., J.S. Allen, L.T. Alexander, and E.P. Hardy, Strontium 90 on the Earth's Surface. IV. Summary and Interpretation of a World-Wide Soil Sampling Program: 1961-1967 Results. 1968, N.Y. TID-24341; 22 p. (U.S. Department of Agriculture, Soil Conservation Service, Soil Survey Laboratory, Beltsville, MD; USAEC, Health and Safety Laboratory, New York Operations Office, New York, NY)

A final world-wide sampling of soil for measuring the distribution and cumulative deposit of Sr 90 from nuclear testing, was conducted from 1961 to 1967. Deposition increments during the time period were very small, indicating that the maximum cumulative deposit probably occurred late in 1966. The latitudinal distribution of Sr 90 shows heaviest fallout between 30 degrees and 60 degrees north latitude, minima at the poles and equatorial region, and a peak in the southern hemisphere between 30 degrees and 50 degrees south latitude. The southern hemisphere peak is about 1/5 the northern hemisphere peak. The total amount of Sr 90 on the earth's surface is 13 MCi, 82 percent of which is in the northern hemisphere. (Auth)

<799>

Michaels, A.S., Simplified Method of Interpreting Kinetic Data in Fixed-Bed Ion Exchange. 1952. Industrial and Engineering Chemistry, 44, 1922-1930 (Massachusetts Institute of Technology, Cambridge, MA)

A model representing the kinetics of a fixed bed ion exchange is presented. The model is applicable to beds containing materials of high exchange rate reactions. (CWF)

<800>

Michalewska, M., and S. Kazimierzczuk, Determination of Strontium in Barium Minerals by Atomic Absorption Spectroscopy. 1971. Chem. Anal., 16, 573-580 (Pilot Plant of Copper Mining and Metallurgical Works, Lubin, Poland)

Atomic absorption spectrophotometry was used for the determination of strontium in barium minerals. Uvispek H-700 spectrophotometer manufactured by Hilger and Watts with acetylene-air flame was used. Absorption of strontium in the presence of interfering cations and anions was measured and the possibility of applying an inhibiting agent was investigated. It was found that the effect of titanium and aluminum on absorption of the strontium line could be eliminated by addition of 300 ppm of calcium or mixed buffer (ammonium salt of EDTA + 2000 ppm La2O3) respectively. The method is valid for a strontium concentration range of 0.5 to 40.0

ppm. The relative standard deviation did not exceed 5%. (Auth)

<801>

Middleton, L.J., Adsorption and Translocation of Strontium and Cesium by Plants from Foliar Sprays. 1958. Nature, 181, 1300-1303 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England; Agricultural Research Council, Field Station, Compton, Berkshire, England)

The foliar absorption of radio-caesium and strontium was determined on a number of agriculturally important plants with water soluble nuclide sources. Results showed that strontium is redistributed in the plants to only a small extent while caesium is relative mobile. (CWF)

<802>

Middleton, L.J., Radioactive Strontium and Cesium in the Edible Parts of Crop Plants after Foliar Contamination. 1959. Int. J. Rad. Biol., 4, 387-402 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England; Agricultural Research Council, Field Station, Compton, Berkshire, England)

The degree of contamination of wheat, potato, cabbage and sugar beet has been investigated after the application of Sr 89 and Cs 137 in a fine spray at different stages in the growth of the plants. The main experimental treatments were applied over two years to obtain information on seasonal effects. The extent to which Cs 137 was concentrated in the edible tissues greatly exceeded that of Sr 89. Usually the concentration of Sr 89 or Cs 137 in each crop varied by less than an order of magnitude irrespective of the state of growth of the crop at the time of contamination and the year in which the experiment was carried out; the Sr 89 content of wheat grain, however, was considerably lower when the plants were contaminated before the ears emerged. A large part of the radioactivity which was deposited on the leaves was removed rapidly by rain; a further fraction was lost as leaves died. The data obtained have been used to predict the probable degree of contamination of crops growing under normal agricultural conditions. (Auth)

<803>

Middleton, L.J., and J. Sanderson, Absorption of Strontium 89 and Cesium 137 by Leaves. 1963. ABCRL-10; (p. 64-70) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

The quantity of radio-strontium and -cesium absorbed by plant leaves was determined by a stripping technique (a commercial preparation which dries to a removable film). The quantity of radioactivity removed by this method is similar to washing in water. High relative humidity enhanced uptake of radionuclide via foliar absorption. (Auth)

<804>

Middleton, L.J., and H.M. Squire, Further Studies of Radioactive Strontium and Cesium in Agricultural Crops after Direct Contamination. 1963. Int. J. Rad. Biol., 6, 549-558 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Investigations have continued on the extent to which Sr 89 and Cs 137 are transferred to the edible parts of cabbage and potato after

<804> CONT.

aerial contamination at various times in the growing season. Significant trends in the concentration of Sr 89 and Cs 137 in the hearts of cabbage and Cs 137 in potato tubers were observed with maximum values after contamination in the middle of the season. A similar trend in the concentrations of Sr 89 in potato tubers was suggested, but no significant differences could be established. The range of concentrations was of the same order as those found in previous years. The present and earlier results have been used to assess the relationships in the field between the deposition of Sr 90 and Cs 137 and their concentration in crops. These relationships show, at least for wheat and potatoes, reasonable agreement with those deduced from surveys of Sr 90 and Cs 137 in foodstuffs resulting from the worldwide dissemination of fall-out from nuclear weapons. (Auth)

<805>

Miettinen, J.K., Radioactive Food Chains in Arctic Regions. 1964. A/CONF-28/P-738; Part of Proceedings of the Third United Nations International Conference on the Peaceful Uses of Atomic Energy held in Finland, May 1964, 12 p. (University of Helsinki, Department of Radiochemistry, Helsinki, Finland)

Investigations of bioenvironmental radioactivity in the arctic regions of Scandinavia and Alaska revealed radioisotope food chains effecting high body burdens of strontium 90 and cesium 137 in animals and man. The most important of these food chains leads from lichens through reindeer to man and causes in reindeer-breeding Lapps and Eskimos up to one-hundred times higher body burdens of cesium 137 than the northern hemisphere average. (Auth)

<806>

Miettinen, J.K., Radioactive Food Chains in the Subarctic Environment, Technical Progress Report, August 15, 1970-August 14, 1971. 1971. NYO-3446-15; 120 p. (University of Helsinki, Department of Radiochemistry, Helsinki, Finland)

The report contains information on the following: cesium 137 content of diet and man in Finland during 1961 through 1971; metabolism in man, biological half-life for: deer - cesium 137 content of caribou and reindeer, in Finland during 1966 through 1971; diet - radioisotope content of, of Lapps in Finland during 1961 through 1971; ecosystems - radioisotope content of aqueous and terrestrial, in Finland; fallout - monitoring in Finland during 1961 through 1971; food chains - radioisotope transport through lichen-reindeer or caribou-man; iron 55 - content of diet and man in Finland during 1962 through 1971; lead 210 - content of aqueous and terrestrial ecosystems in Finland; man - radioisotope content of Lapp, in Finland during 1961 through 1971; meats - reindeer, radioisotope content in Finland during 1966 through 1971; plants - radioisotope content in Finland during 1970, antimony 125, cesium 137, manganese 54, ruthenium 106, and zirconium 95; polonium 210 - content of aqueous and terrestrial ecosystems in Finland; potassium 40 - content of man, measured by whole-body counting; sodium 24 - metabolism in man, biological half-life for. (NSA)

<807>

Milbourn, G.M., The Uptake of Radioactive Strontium by Crops Under Field Conditions in the United Kingdom. 1960. Journal of Agricultural

Science, 55, 273-281 (Agricultural Research Council, Radiobiological Laboratory, Berkshire, England; Agricultural Research Council, Field Station, Compton, Berkshire, England)

Field experiments are described in which the absorption of radioactive strontium by rye-grass and lucerne has been investigated during 1958 on five soil types which represent a range in exchangeable soil calcium content. Sr 89 was applied as a spray to both arable land and to established pasture. Absorption was reduced by a factor of up to 4 in rye grass (shallow rooted) following ploughing to 11 in. compared with leaving the contamination on the soil surface. These results are compared with those obtained in an earlier series of experiments in 1957. The ratio of Sr 89 to calcium was highest in crops grown on soil low in calcium (2 m-equiv. Ca per 100 g. extracted with N-ammonium acetate). The addition of lime reduced absorption of Sr from the soil only when the exchangeable soil calcium content was relatively low. Some effect was observed in soils containing 7-8 m-equiv. Ca/100g., a considerably larger one in a soil containing 2m-equiv. Only small differences occurred in the ratio of Sr 89 to calcium between lucerne and rye grass. This comparison was not made beyond the first 6 months of growth. Experiments carried out with established pastures on four soil types indicate that Sr 89 is more readily absorbed from the 'plant-base' than after incorporation with soil. Ploughing and reseeded may reduced the ratio of Sr 89 to calcium in herbage by a factor of up to 4. This effect may be greater on mature swards. The lining of contaminated swards reduces the ratio of Sr 89 to calcium in herbage by a factor of 2 to 3 regardless of the calcium content of the soil, and liming followed by ploughing and reseeded by a factor of 3 to 7. (Auth)

<808>

Milbourn, G.M., F.E. Ellis, and R.S. Russell, The Absorption of Radioactive Strontium by Plants under Field Conditions in the United Kingdom. 1959. Journal of Nuclear Energy, Part A: Reactor Science, 10, 116-122 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England; Agricultural Research Council, Field Station, Compton, Berkshire, England)

The absorption of radioactive strontium by crop plants has been investigated in field experiments on six soils which represent a wide range of arable land in Britain. Sr 89 was applied as a spray, and cultivation procedures were employed to place it at different depths below the soil surface. Three test crops were grown in each experiment. With shallow-rooted crops, for example, a grass-clover pasture mixture, ploughing to the depth of 12 in. caused the absorption of Sr 89 and the ratio of Sr 89 to Ca in plants, to be on the average, less than 30 percent of that observed when the Sr 89 was left on the surface. Only small effects of placement, however, occurred with deeper rooted species. When established pasture was contaminated the level of Sr 89 in the tissues formed subsequently was up to 5 times higher than in grass sown on contaminated ground. The effects of the Ca status of the soil and of added lime were examined. The Sr 89 content of plants and the ratio of Sr 89 to Ca were highest when the soil was low in Ca (2 milli-equivalents Ca per 100 g extracted with N ammonium acetate). Relatively small differences, however, occurred when the soils contained more than 7 milli-equivalents Ca. The effect of added lime was variable and

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differences between experiments cannot be attributed entirely to differences in soil calcium. (Auth)

<809>

Miller, J.R., and R.F. Reitemeyer, The Leaching of Radiostrontium and Radiocesium through Soils. 1963. Soil Science Society of America Proceedings, 27, 141-144 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Beltsville, MD)

Sr 90 and Cs 137 are hazardous, long-lived, nuclear fission products. Experiments were conducted in the greenhouse to determine their downward movement in soils under intensive leaching. The five soils (Norfolk, Hagerstown, Miami, Fort Collins, and Huntley Series) selected for the investigation represented a wide range of soil properties, and the leaching treatments consisted of 30 inches and 300 inches of deionized water, 0.005N NaCl, and 0.005N CaCl₂. There was little downward movement of Cs 134 when the soils received the applications of deionized water, NaCl, or CaCl₂. Radioactive assays of the soil columns showed that 96.6 to 100 percent of the Cs 134 was in the surface two layers of the soil columns (average depth 1.4 inches) after 300 inches of leaching. In the leaching experiment with Sr, the CaCl₂ produced the greatest movement of Sr 89 and deionized water the least. The maximum distance Sr 89 penetrated into the soils when leached with 30 inches of water was 1.3 inches, and with 300 inches of water the distance was 4.3 inches. In general, there was more movement of Sr 89 in the Norfolk soil and least in the Huntley, with the other soils being intermediate. (Auth)

<810>

Millikan, C.R., and B.C. Hanger, Movement of Foliar-Applied Calcium 45 in Brussels Sprouts. 1969. Aust. J. Biol. Sci., 22, 545-558 (Victorian Plant Research Institute, Burnley, Australia)

Calcium 45 remained virtually immobile when applied to the surface of the middle leaves of Brussels sprouts in doses containing extra nonradioactive calcium plus either water, citric acid, malic acid, diphenylamine, dimethylsulphoxide, or oxalic acid. By contrast, the mobility of Ca 45 injected in the midrib of corresponding leaves was markedly influenced by the nature of the additive. Water, diphenylamine, dimethylsulphoxide, or oxalic acid had little effect, while citric acid and malic acid resulted in acropetal and basipetal movement. Even after 7 days, the movement was largely restricted to the side of the plant with the treated leaf in the middle. The movement of methylene blue added as a marker to the injected Ca 45 dose containing extra nonradioactive calcium plus malic acid remained largely confined to the xylem of the petiole and later up and down in the xylem of the stem. Ca 45 had moved ahead of the marker after 10 min and occurred in all vascular tissues and surrounding parenchyma of the petiole. Movement of Ca 45 away from the xylem was first apparent 20 min after injection. At 60 min Ca 45 occurred in fascicular parenchyma, phloem, and phloem parenchyma, but not in the xylem. Movement of Ca 45 in the stem occurred in phloem as well as in xylem. These differences in the movement of marker and Ca 45 were recorded for dry, moist, and saturated plants. (Auth)

<811>

Millikan, C.R., B.C. Hanger, and E.N. Bjarnason, Effect of Phosphorus and Zinc Levels in the Substrate on Zinc 65 Distribution in Subterranean Clover and Flax. 1968, August. Aust. J. Biol. Sci., 21, 619-640 (Victorian Plant Research Institute, Burnley, Australia)

Subterranean clover (*TRIPOLIUM SUBTERRANEUM*) and flax *LINUM USITATISSIMUM* were grown in water cultures containing Zn 65 and all combinations of deficient or normal Zn supply and low or excess phosphate levels. The Zn 65 distribution in the plants was determined by autoradiographs and radioassays. Irrespective of P or Zn level in the substrate, the overall trend was a fall in Zn 65 concentration with time in all aerial tissues of both species. However, the variation in Zn 65 concentration with Zn deficient plants showed considerable relative differences from that within plants with a normal Zn supply, both between comparable tissues, and with time. In Zn deficient subterranean clover a greater percentage than normal of the total Zn in the plant was located in the roots. With flax the Zn 65 concentrations in leaves and stems varied independently with time. In this species Zn 65 accumulated in the nodes and as islands of high concentration in the oldest leaves. Within Zn deficient plants of both species, Zn 65 concentrations were highest in tissues actually involved in Zn deficiency symptoms, i.e., little leaves of subterranean clover, or the apical tissues of flax affected with dieback. There was considerable retranslocation of Zn from the oldest leaves of Zn deficient subterranean clover. Increase in phosphate supply caused increased Zn 65 concentrations in the oldest leaves of subterranean clover at deficient Zn levels, and also had differential effects on the relative distribution of Zn 65 within lamina and petiole depending on the level of Zn supply. Plants showing little leaf symptoms had P/Zn ratios greater than 400 in their tops. Difference in phosphate supply had no significant effect on Zn 65 distribution in flax. (Auth)

<812>

Millikan, C.R., B.C. Hanger, and E.N. Bjarnason, The Mobility of Zinc 65 in *TRIPOLIUM SUBTERRANEUM* L. and *ANTIRRHINUM MAJUS* L.. 1969, April. Aust. J. Biol. Sci., 22, 311-320 (Victorian Plant Research Institute, Burnley, Australia)

T. SUBTERRANEUM (cv. Clare) and *A. MAJUS* were grown in nutrient cultures to which Zn 65 was added at two stages in the plants' development. It was found that the Zn 65 recently absorbed by the roots was preferentially routed to the youngest leaves. When the plants were transferred from radioactive to nonradioactive cultures, only a limited recirculation of Zn 65 took place. In *T. SUBTERRANEUM* this was principally from the roots and hypocotyl, but also between and within some leaves, while in *A. MAJUS* recirculation occurred along the stem, roots, and within some leaves. Injection of 1000 ug of nonradioactive zinc into the third true leaf of *T. SUBTERRANEUM* failed to alter the distribution of Zn 65 between leaves, although it did induce movement of Zn 65 along the petiole into the lamina of some individual leaves. (Auth)

<813>

Millikan, C.R., B.C. Hanger, and E.N. Bjarnason, Interaction Between Calcium Level and Nitrogen

<813> CONT.

Source on Growth and Calcium 45 Distribution in Subterranean Clover. 1969. Aust. J. Biol. Sci., 22, 535-544 (Victorian Plant Research Institute, Burnley, Australia)

Using either ammonium or nitrate as the nitrogen sources, dry matter yields were highest from plants grown on a normal calcium nutrition, whereas plants supplied with urea grew best at low calcium level. (NSA) (NSA) (NSA) When ammonium and nitrate were added together, yields were independent of the calcium concentration in the substrate. Plants fed solely ammonium nitrogen made extremely poor growth. The main factor affecting Ca 45 distribution within subterranean clover was the calcium concentration in the substrate. The percentage of Ca 45 retained in the roots was greatest at the low calcium level. At this level it was also greatest in the plants fed ammonium and least in those fed ammonium plus nitrate. The concentration of Ca 45 in plant tops was equal in the presence of ammonium plus nitrate or urea, and higher than with nitrate with nitrate or ammonium. Between nitrogen sources the lamina:petiole, leaf edge:leaf center, and petiole distal:petiole proximal ratios of Ca 45 concentrations were different at the low, but not at the normal, calcium level.

<814>

Hills, H.L., and L.M. Shields, Root Absorption of Fission Products by *EROMUS RUBENS* L. from the AEC Nevada Test Site Soil Contaminated by an Underground Nuclear Explosion. 1961. Radiation Botany, 1, 84-91 (New Mexico Highlands University, Department of Biology, Las Vegas, NM)

By the Neubauer type of culture, *EROMUS RUBENS* L. plants were grown to maturity in soil from a crater formed by an underground nuclear detonation (Blanca event) at the Nevada Test Site. Plants and soil were analysed to determine the extent of root absorption of fission products. Of total plant radioactivity, ruthenium-rhodium 106 comprised 42.3 percent; strontium-yttrium 90, 46.6 percent, lanthanide rare earths (cerium-praseodymium 144), 10.2 percent and zirconium-niobium 95, 0.9 percent. Of the total soil radioactivity, the combined leaf-stem-inflorescence-grain portions of the total crop were found to contain 0.34 percent of the strontium-yttrium; 0.065 percent of the soil ruthenium-rhodium 106; 0.0625 percent of the zirconium-niobium 95; and 0.01125 percent of the soil lanthanide rare earths. Activity ratios of plant/soil showed absorption coefficients of 36 for strontium-yttrium; 3.3 for ruthenium-rhodium 106; 0.63 for lanthanide rare earths; and 0.3 for zirconium-niobium 95. Absorption coefficients for leaf-stem fractions were 29.1 for strontium-yttrium; 6.5 for ruthenium-rhodium; 1.75 for lanthanide rare earths; and 0.61 for zirconium-niobium. Absorption coefficients for grain-inflorescence fractions were 13.04 for strontium-yttrium; 2.1 for ruthenium-rhodium; 0.2 for zirconium-niobium; and 0.175 for the lanthanide rare earths. On a comparative dry weight basis, the leaves-stems portion accumulated a higher percentage of soil radioactive contaminants than the inflorescence-grain portion. While comprising only 29 percent of total plant dry weight, the leaves-stems tissues accumulated 80.35 percent of the lanthanide rare earths, 55.8 percent of the ruthenium-rhodium 106, 55.1 percent of the zirconium-niobium 95, and 47.6 percent of the strontium-yttrium 90. The grain-inflorescence tissues, while comprising 71 percent of the total plant dry weight,

accumulated 52.4 percent of the strontium-yttrium 90, 44.9 percent of the zirconium-niobium 95, 44.2 percent of the ruthenium-rhodium 106, and 19.65 percent of the lanthanide rare earths. Leaf-stem accumulation shows ratios of 2.77 for lanthanide rare earths, 1.97 for ruthenium-rhodium 106, 1.94 for zirconium-niobium 95, and 1.63 for strontium-yttrium 90. Grain-inflorescence accumulation shows ratios of 0.277 for the lanthanide rare earths, 0.635 for ruthenium-rhodium 106, 0.649 for zirconium-niobium 95, and 0.728 for strontium-yttrium 90. (Auth)

<815>

Minotti, P.L., D. Craig, and W.A. Jackson, High Cesium Uptake in Wheat Seedlings Cultured with Ammonium. 1965. Soil Science Society of America Proceedings, 29, 220-221 (North Carolina State of the University of North Carolina, Department of Soil Science, Raleigh, NC)

Wheat seedlings grown exclusively on $\text{NH}_4\text{-N}$, relative to those grown exclusively on $\text{NO}_3\text{-N}$ or without N, consistently demonstrated a markedly high capacity for subsequent Cs absorption from solutions labelled with Cs 137. In addition, previous nitrogen nutrition greatly influenced the relative distribution of absorbed Cs, with percentage transport of Cs to tops being greatest in seedlings cultured with NO_3 . The results could not be explained on the basis of either K content or respiratory substrate levels prior to the uptake periods. (Auth)

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Mironov, B.A., and E.M. Karavaeva, Influence of Soil Moisture on the Behavior of Sulfur 35, Cobalt 60, and Strontium 90 in the Soil-Plant System. 1968. Tr. Inst. Ekol. Rast. Zhivotn., 61, 35-46

Experiments on the concentration of three radioisotopes in plants showed that Sulfur 35 was heavily concentrated, Strontium 90 was concentrated one or two orders of magnitude less, and Cobalt 60 three orders of magnitude less. At low soil moistures, Sulfur 35 concentrations were decreased in pea plants by one order of magnitude and by two orders in barley plants in comparison with concentrations at high soil moisture values. Strontium 90 was concentrated most intensively in plants at high soil moisture values and slightly less at low and average values. The highest concentration of Cobalt 60 in pea plants was observed at low soil moisture values, and in barley plants at high values. The concentration of Strontium 90 and Cobalt 60 in pea plants varied to considerable extent under different experimental conditions. Variations were not as great in barley plants. The concentration of Sulfur 35 differed less significantly with changes in experimental conditions. The distribution of Cobalt 60 in the organs of pea and barley plants at all levels of soil moisture was acropetal. Changes in the soil moisture altered the distribution of Sulfur 35 concentrations in the organs of pea plants, but in the opposite direction. The general accumulation of radioisotopes by vegetation in all aspects of the experiment was decreased with the decrease of soil moisture. For Cobalt 60, it was 0.10 percent of the quantity introduced for Strontium 90--0.1 percent, and for Sulfur 35--0.12 percent. Changes in soil moisture had an insignificant effect on the migration of Strontium 90, yet a reduction of moisture slightly increased migration. The influence

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of vegetation was significant, especially in regards to increased Strontium 90 migration in soils at high and average moisture levels. Cobalt 60 migration was analogous, but the intensity of migration was less and vegetation only slightly increased it at low soil moistures. The influence of soil moisture led to reductions in migration. Vegetation promoted significantly the migration of Sulfur 35 in soil at high and average moisture levels and reduced it at low levels. (tr-Auth)

<817>

Mishra, U.C., and S. Sadasivan, Fallout Radioactivity in Indian Soils. 1973. Health Physics, 23, 55-62 (Bhabha Atomic Research Centre, Bombay, India)

Gamma spectrometric measurements of Ce 144, Ru 106, Sb 125 and Cs 135 activities, products of fallout in samples of Indian soils, were obtained. The samples were collected during 1966-1970 from a number of places in India. Some of the samples were analysed for Sr 90 by conventional chemical methods and beta counting. The ratios of Cs 135/Sr 90 were studied. The results were compared with global Sr 90 soil measurements and the important differences were brought out. The variations of concentrations with depth, rainfall, latitude, etc. were discussed. The external gamma dose rates due to fallout gamma emitters in soils were computed and compared with estimated dose rates due to natural radioactivity. (Auth)

<818>

Mishra, U.C., and S. Sadasivan, Gamma Spectrometric Measurement of Soil Radioactivity. 1971. Int. J. Appl. Radiat. Isotop., 22, 256-257 (Bhabha Atomic Research Centre, Air Monitoring Section, Bombay, India)

A gamma spectrometric method for determining contents of gamma emitting isotopes in soil sample is described. (CWF)

<819>

Moeller, P., Isolation of the Radionuclides Beryllium 7 and Beryllium 10 from Rainwater and Soil. 1970, August. J. Inorg. Nucl. Chem., 32, 2473-2481 (Hahn-Meitner Institute fuer Kernforschung, Berlin, German Federal Republic)

A method is given for isolating Be as Be(OH)₂ in a chemically pure form from rainwater and soil. It was found that Be(OH)₂ contains only the radionuclides Be 7 and Be 10. The high selectivity of the chemical treatment was demonstrated by isolating Be 7 and Be 10 from soil and Be 10 produced by neutron irradiation of Be metal. Means of identification of Be 7 and Be 10 in the samples are discussed. (Auth)

<820>

Moeller, P., and K. Wagners, Dating Soil Layers by Beryllium 10. 1967, March, 2-10. CONF-670309: ST/PUB-152; Part of Proceedings of a Symposium on Radioactive Dating and Methods of Low-Level Counting held in Monaco, France, March 2-10, 1967 (Hahn-Meitner Institute fuer Kernforschung, Berlin, German Federal Republic)

The main problems in dating soil layers by the cosmogenic nuclide Be 10 is the isolation of beryllium from big quantities of sample materials. The following chemical process was used: leaching the sample material with HCl, extraction of Be as acetylacetonate, and ion exchange on diallyl phosphate. It is thus

possible to isolate Be(OH)₂ in a chemically pure form containing no other radionuclides. This procedure was tested by the determination of Be 7 accumulated in soil. The measured Be 7 activity corresponds well with the mean activity of Be 7 in rain water. Besides humic acids in soils metal hydroxides are able to concentrate Be to a large extent. Thus Be 10 was found in iron ore deposits containing limonite. A calculation of the Be 10 production rate is given and the possibility of radioactive dating with Be 10 using the chemical process mentioned above is discussed. (Auth)

<821>

Moiseev, A.A., I.E. Mukhin, R.I. Pogodin, Z.G. Antropova, and G.V. Filimonov, Peculiarities of the Migration of Total Cesium 137 from Sandy Podzolic Soils through the Food Chain into the Human Body. A-AC-82/G/L-1187; AEC-tr-7030; (p. 1-12)

Soil, hay, cereals, milk, meat, and total diet for the inhabitants of two populated sites were sampled in November, 1966, and the Cs 137 body burden of people of various age groups was measured with a portable single-channel gamma spectrometer. Tables are presented to show results. On transferring from turf-podzolic sandy soils along the food chain, Cs 137 reaches higher levels in vegetation, in agricultural products (meat and milk), and in the body of the inhabitants of that district. Increased Cs 137 content in individual links of the soil-vegetation-cow-man chain is caused only by specific conditions of the soil in the given area, that fixes the fallout Cs 137 only weakly. The average body burden of Cs 137 of adults living in these areas is 55 u Ci. The internal Cs 137 gonad doses to the adult population of the area fluctuated from 3 to 17 mrad/yr. (Auth)

<822>

Moiseev, A.A., Yu.A. Polyakov, A.N. Marei, E.V. Petukhova, G.G. Polikarpov, A.S. Zykova, I.L. Karol, V.V. Pavlov, G.P. Krasnoshchekova, Yu.S. Stepanov, E.B. Tyuryukanova, G.A. Fedorov, P.V. Ramzayev, V.F. Brendakov, S.M. Vakulorskiy, and A.P. Yermolayeva-Makovskaya, USSR Reports on Natural and Fallout Radioactivity. 1969. AEC-tr-7030 (Not given)

This series of articles concerns the migration through soils and food chains, soil diffusion and distribution, dietary intake and human levels, environmental levels, concentration processes, fallout deposition, and metabolism of Sr 90 and Cs 137. Two additional articles on an instrument for determination of Sr 90 content in seawater and environmental and human content of Po 210 are included. (ST)

<823>

Moiseev, I.T., R.M. Aleksakhin, and S.G. Rydkii, Effect of the Introduction of Sodium Silicate and Trisodium Phosphate into Soils on the Accumulation of Strontium 90 Crops. 1969. A-AC-82/G/L-1295; 16 p. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

Wheat and pea plants were grown in metal vessels containing 4 kg of air-dried soil (chernozem or podzolic). On treating the soils with sodium silicate or trisodium phosphate in amounts equivalent to the content of exchange calcium in the soil, it was observed that the strontium 90 content in the grain part of the plant decreased by a factor

<823> CONT.

of 3 to 5. The decrease in the leaf and stem was greater than in the grain part of the plant. A decrease in the amount of added chemical by a factor of two (50 percent of the exchangeable calcium) led to a relatively sharp increase in strontium uptake. The effect of sodium phosphate is greater than that of sodium silicate in decreasing the strontium uptake by the plant. Field experiments with additions of sodium silicate equivalent to 200 to 300 of the exchangeable calcium led to a significant decrease in the grain (by a factor of 3 to 13) and in the chaff (by a factor of 2.5 to 7) in the first year, but the absorption of strontium 90 by the plants increased in the second year. (Auth)

<824>

Moiseev, I.T., R.M. Aleksakhin, and S.G. Rydkii, Effect of Treating Soil with Kcsin and a Mixture of Aniline and Furfural on the Uptake of Strontium 90 by Crops. 1969. *Agrokhiimiya*, 12, 105-112 (Moscow State University, Akhva, USSR)

Tillage of earth that had been treated with rosin and a 2-furalde- hyde and aniline mixture into a depth of 50 cm decreased the accumulation of Sr 90 in plants by 38 to 50 percent. The temporary toxicity of the compounds in the upper soil layers led to a decrease in yield of 20 to 50 percent. (tr-Auth)

<825>

Moiseev, I.T., R.M. Aleksakhin, and S.G. Rydkii, Actual and Residual Effect of Sodium Silicate and Trisodium Phosphate on Accumulation of Strontium 90 in the Harvest. 1969. *Agrokhiimiya*, 6, 88-95

Significant reductions in the uptake of strontium 90 in the grain and straw of wheat was accomplished by treating the contaminated soils with sodium silicate and trisodium phosphate (200-300 percent of the exchangeable soil calcium). The phosphate salt reduces strontium 90 uptake to a greater extent than the silicate salt, but in both cases the depression in radiostrotrnium uptake is short termed. (CWF)

<826>

Mokady, R., and M. Gal, Strontium Fixation by Lime Contained in Soils. 1964. *Science*, 145, 154-155 (National and University Institute of Agriculture, Rehovot, Israel)

The suitability of soils for the disposal of radioactive strontium waste products is determined in part by the amount and properties of calcium carbonate in the soil. Analyses of the strontium ion concentrations in the effluent solution of soil columns and x ray diffraction patterns suggest that a fraction of the strontium ions is precipitated as strontium carbonate. (Auth)

<827>

Mokady, R.S., and D. Zaslavsky, On the Use of Radioactive Tracers in Diffusion Experiments. 1967. *Soil Science Society of America Proceedings*, 31, 604-608 (Israel Institute of Technology, Haifa, Israel)

A theoretical analysis was made of the limitations in the application of radioisotopes in soil diffusion experiments, either as tracers or in self diffusion experiments. Limitations of the tracer technique of 2 types are examined. The first

is due to different modes of adsorption or immobilization of the tracers and the carrier. In the course of their movement in soils, by convection or diffusion, many ionic and molecular species react with the soil. Thus, the flow is not a simple process but rather involves sources and sinks. These sources and sinks may be different for the carrier and the tracer. In such cases the tracer may not be a simple representative of the carrier. The second type of limitations refers to the similitude between the flows of the tracer and the carrier when the decay is conventionally corrected. In using an isotopic tracer, perfect analogy to the carrier is obtained when the differential equation and the boundary conditions become analogous for the flows of both the tracer and the carrier, once the correction for the decay is used. The resemblance of the 2 flows is discussed for the case of stable and radiophosphorus diffusion in soils with sinks. (NSA)

<828>

Mokma, D.L., M.L. Jackson, J.K. Syers, and P.R. Stevens, Mineralogy of a Chronosequence of Soils from Graywacke and Mica- Schist Alluvium, Westland, New Zealand. *New Zealand Journal of Science* (University of Wisconsin, Department of Soil Science, Madison, WI)

Organic matter-free clays tended to fix more strontium than those containing organic matter. Older soils tended to fix decreasing quantities of radiostrotrnium than younger soils indicating that as the crystallinity increases the fixation mechanisms becomes less prominent. (CWF)

<829>

Molchanov, A.A., Distribution of the Major Radioactive Fission Products and Some Stable Isotope Carriers of Radionuclides in Forest Vegetation of the Far East. 1970. *OLS-19171; Lesovedenie*, 3, 13 (Not given)

Concentrations of Sr 90, Ru 106, Sb 125 and Cs 137 from global fallout in forest vegetation and leaf was determined in the Far East in 1967. The Sr 90:Cs 137 ratio in various plant parts varied from 2 up to 10-15; this behavior is indicative of the important role of entry of Sr 90 from the soil into the root system. On the basis of analysis of Sr 90/Sr, Sr 90/Ca and Cs 137/K ratios in woody plants, an estimate was made of the contribution of the root entry path to the total accumulation of Sr 90 in various parts of the tree. (Auth)

<830>

Molchanov, A.A., E.A. Fedorov, R.M. Aleksakhin, M.M. Aleksakhina, M.N. Mishenkov, M.A. Maryshkin, L.N. Tyumenev, V.A. Ukhanova, and V.P. Yulanov, Some Patterns of Distribution of Major Radioactive Fission Products Deposited from the Atmosphere in Global Fallout in Forests of Various Areas of the USSR During the Period 1964-1965. 1968. *A-AC-82/G/L-1302*; 10 p. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

Samples of forest litter and of different parts of trees were selected in a number of forests of the European part of the USSR in the autumn of 1964 to 1965. The samples were ashed at 500 degrees C, and analyzed radiochemically for strontium 90, zirconium 95, niobium 95, ruthenium 106, cesium 137, and cerium 144. The highest concentration of fission products was noted in the forest litter, while the lowest was found in the tree wood. The tree parts such as needles, leaves,

<830> CONT.

bark, branches, and roots occupy an intermediate position with a concentration of 10(E-9) to 10(E-10) Ci/kg of air-dried material. The radionuclide concentration in the tree wood is a factor of 10 to 100 lower, while the concentration is a factor of 10 higher in the forest litter. (NSA)

<831>

Molchanov, A.A., M.A. Maryshkin, R.M. Aleksakhin, E.A. Fedorov, N.N. Mishenkov, V.P. Julianov, L.N. Tiunenev, V.V. Ustinov, and V.A. Ukhanova, On the Distribution of Main Radioactive Fission Products and of Certain Stable Isotopes-Radionuclides Carriers in the Forest Vegetation in Primorie. 1970. *Akademiya Nauk SSSR*, 3, 14-21

Data on distribution of radioactive fission products resulting in world fallout are presented for the Far East forests (Sputnik natural reserve). The concentration of various radioactive nuclides in over- and underground tree organs is estimated as well as the possible modes of entry. Data indicate that greater than 50 percent of the strontium 90 content in the coniferous forests was accumulated through foliar deposition rather than root uptake. (Auth) (CWF)

<832>

Molchanova, I.V., Behavior of Cerium 144 in Various Types of Soil. 1968. *Tr. Inst. Ekol. Rast. Zhivotn.*, 61, 4-11

Microquantities of Ce 144 in solution at acid pH values were completely absorbed by the types of soils that were studied. In the range of neutral and alkaline pH values, the absorption of cerium by soils was decreased. The type of soil also had an effect on the stability of cerium binding in the soil. The cerium was bound most securely in turf-meadow soil and black soil (chernozem). Absorbed cerium was more easily removed from all soils by the salts of iron than by salts of aluminum and copper. The presence of colloids of iron in the solution decreased the absorption of cerium by soils in the range of pH values studied. The percent sorption of Ce 144 by soils decreased more sharply as a result of the presence of iron colloids than the concentration of iron in the solution. Aqueous extracts from the leaves of ligneous plants increased the mobility of cerium in the soil-solution system for all of the types of soils studied. (tr-Auth)

<833>

Molchanova, I.V., The Uptake of Radioisotopes Yttrium 91 and Cerium 144 in Plants from Nutrient Solutions and Soils. 1968. *Academy of Science, USSR*, 61, 21-25

Yttrium 91 uptake in plants from nutrient solutions exceeded cerium 144 uptake by several fold, however, the magnitude of uptake from soils was similar. Yttrium 91 was found to be more mobile than cerium 144. (CWF)

<834>

Molchanova, I.V., Plant Uptake of Microquantities of Yttrium 91 and Cerium 144 from Nutritive Solutions and Soil. 1968. *Tr. Inst. Ekol. Rast. Zhivotn.*, 61, 31-34

Following a study of the uptake of microquantities of Y 91 and Ce 144 by pea and barley plants from nutrient solutions and soils, their distribution in plants was established. The mobility of Y 91 was greater

than that of Ce 144. The transport of yttrium by plants and the coefficients of its accumulation in the above-ground parts of the plants were several times greater than these quantities for cerium. Yttrium 91 and Ce 144 that were taken up by plants from nutrient solutions, were accumulated mainly in roots. Following uptake from soil, an even distribution of the radioisotopes in the plant was noted. (tr-Auth)

<835>

Molchanova, I.V., E.M. Karavaeva, and N.V. Kulikov, Influence of Soil Moisture Content on Strontium 90 Uptake by Plants. 1972. *Soviet Journal of Ecology*, 3(3), 257-259 (Institute of Plant and Animal Ecology, Moscow, USSR)

In greenhouse experiments, radiostrontium uptake in plants was determined at 3 soil moisture levels, 27, 17 and 10% by soil weight. The distribution coefficient (activity per gram plant material/activity per gram of soil) remained constant at all 3 moisture levels. Because radiostrontium concentration in the soil solution varied inversely with soil moisture content, it was concluded that plant uptake of radiostrontium is more dependent on contact exchange mechanisms rather than uptake from soil solution the phase. (CWF)

<836>

Molchanova, I.V., and N.V. Kulikov, Distribution of Strontium 90 and Cesium 137 in the Soil and Vegetation Cover of the Tundra. 1970, December. *Dokl. Akad. Nauk SSSR*, 195, 959-961 (Institute of Plant and Animal Ecology, Sverdlovsk, USSR)

The distribution of radioisotopes in the soil and vegetation of the European section of the USSR has been studied but little is known on this subject with respect to the Far North and especially the tundra region; therefore, a comparative study was carried to determine the distribution of Sr 90 and Cs 137 in various types of soils and vegetation of the tundra. The examined area included peaks, moraine ranges and foothills of the watershed together with marshy peat-bog areas. During July 1966, specimens were collected from each of the soil types and from the vegetation which consisted mostly of moss and lichen. The Sr 90 content of the collected samples was determined radiochemically from the concentration of the Y 90 daughter product; the Cs 137 concentration was determined by means of a multichannel gamma analyzer. The results indicated that these radioisotopes are primarily concentrated in the plants; Sr 90 which has a tendency to migrate is accumulated in the soil. (NSA)

<837>

Molchanova, I.V., and N.V. Kulikov, Radioactive Isotopes in the Soil-Plant System. 1973. *Ecology (USSR)*, 4, 88 (Laboratory of Silviculture, Academy of Sciences, USSR)

This book review by R.M. Aleksakhin summarizes the results of many years of experimental study on the migration of Fe 59, Co 60, Y 91, and Ce 144 within the soil-plant system. Study of radionuclide turnover in the external environment is one of the central tasks of radioecology. A valuable feature of this book is that the authors have generalized their data on the migration within the soil and vegetation cover of radionuclides which, on the whole, are little studied and which are of considerable interest as a source of contamination. Two of the above radionuclides

<837> CONT.

are characterized by rather long half-lives ($T_{1/2}$ for Ce 144 and Co 60 is, respectively, 284.5 days and 5.26 years), so that their behavior in the environment is being closely followed. Experimental data on the migration of Fe 59, Co 60, Y 91 and Ce 144 are given for three different systems in the increasing order of complexity: soil-solution, soil-plant, and, finally, the soil-vegetation cover of natural biocenoses. Placed in this order, the results could be treated consecutively in relation to the interaction between the nuclides under study and the solid phase of soil (sorption-desorption processes), their accumulation in plants, and the effect of some ecological factors on radionuclide migration in soils and plants under natural conditions. From the standpoint of methodology, it should be noted that use of radioactive indicators has made it possible to investigate more fully the migration mechanisms of iron, cobalt, yttrium, and cerium within the soil-plant system: this would have been a rather complex procedure without the use of radioactive tags. So in this respect the work of Molchanova and Kulikov is of great significance not only in the field of radioecology but also in the field of biogeology. The two books are of interest not only to radioecologists but also to general ecologists, biogeochemists, radiobiologists, specialists in the field of radiation hygiene, and to all those interested in the problem of radionuclide migration over the biosphere and of the effect of ionizing radiation on biocenoses. (Auth)

<838>

Moorby, J., Movement of Cesium in Plants. 1963. ARCRL-10: (p. 70-72) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Cesium 137 movement in pea plants appeared to be related directly to the concurrent movement of sugars or dependent on some metabolic processes which control the production and transport of sugars in the plant. Translocation of cesium 137 to plant parts below the treated leaf was reduced in darkness but increased in plant parts above the treated leaf. (CWF)

<839>

Moorby, J., and H.M. Squire, The Entry of Strontium into Potato Tubers after Foliar Contamination. 1963. Radiation Botany, 3, 95-98 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

When the foliage of potato plants was sprayed with radioactive strontium and the plants grown in the open a small quantity of the strontium passed into the tubers. This could be prevented by protecting the plants from rain and covering the soil. The contamination of tubers from plants exposed to rain was not due to the translocation of strontium within the plant, but was caused by strontium washed from the leaves by rain. Strontium which entered the tubers in this way appeared to do so three times as readily as strontium applied to the soil at the time the potatoes were planted. (Auth)

<840>

Morard, P., and R. Bur, Comparison of the Use of Rubidium 86 and Potassium 42 as Radioactive Tracers in the Study of Potassium Absorption by Sorghum. 1972. CONF-711213; IAEA/SM-151/15. Part of Proceedings of a Symposium on the Use of

Isotopes and Radiation in Research on Soil-Plant Relationships Including Applications in Forestry held in Vienna, Austria, Dec. 13-17, 1971, (p. 59-66) (Ecole Nationale Supérieure Agronomique, Toulouse, France)

As there are no potassium radioisotopes convenient to use (half-life too short or too long), many authors have agreed that Rb 86 can be an appropriate tracer of K. In order to test this hypothesis, the authors conducted two absolutely identical experiments using Rb 86 or K 42 as tracers. The radioisotopes are introduced into the nutrient solution and brought into contact for one, six, nine, and twenty-four hours with part or the whole of the sorghum root system at the seven-leaf stage. The results demonstrate differences in the behavior of the two tracers, both as regards their total absorption and their distribution within the plant. In the case studied, Rb 86 is not a satisfactory tracer of potassium for studying the absorption and distribution of the element in whole plants. (Auth)

<841>

Morqan, A., The Uptake of Strontium 90 by Ryegrass. 1959. Journal of Nuclear Energy, Part A: Reactor Science, 11, 8-13 (Atomic Energy Research Establishment, Harwell, Didcot, Berkshire, England)

It is shown that 20 percent of the 'fallout' Sr 90 deposited in rain can appear in the aerial parts of ryegrass growing during the period of deposition. It is considered that almost all this activity is taken up directly by the leaves, stems and surface roots and not by the roots in the soil. This suggests that rate of fallout is the controlling factor in determining the Sr 90 content of grass. The 'fallout' Sr 90 in the three soils used in the experiment was not less available to the ryegrass than freshly added Sr 85, suggesting that the availability of Sr 90 does not decrease to any appreciable extent with time. (Auth)

<842>

Moroz, B.B., and Yu.D. Parfenov, Effects of Polonium 210 On the Organism. 1971. IEC-tr-7300; 170 p. (Not given)

Polonium 210, one of the most toxic radioactive isotopes, presenting great hazard when taken into the organism, is widely used in the atomic industry. This book generalizes the results of investigations conducted in the USSR and abroad on the pathological physiology of acute and chronic radiation sickness induced by incorporated Po 210. The basic principles of the biological effects of Po 210 are discussed in comparison with the effects of external irradiation. Considerable attention is paid to the reaction of the cardiovascular and endocrine systems, problems of toxicology, early diagnosis, and long-term effects. The book is designed for a wide circle of researchers working in the field of radiobiology and radiation medicine, and is also designed for physicians and engineers involved with the service of radiation safety. There are 13 tables, 417 bibliography titles and 32 illustrations. (Auth)

<843>

Mortensen, J.L., Complexing of Metals by Soil Organic Matter. 1963. Soil Science Society of America Proceedings, 27, 179-186 (Ohio Agricultural Experiment Station, Wooster, OH)

<843> CONT.

Soil organic matter forms complexes with metals by ion-exchange, surface adsorption, chelation, and complex coagulation and peptization reactions. Little is known concerning the nature of the ligands in polymeric components of soil organic matter which chelate metals, but carboxyl, hydroxy, and amide groups are probably involved. A number of low molecular weight compounds capable of chelating metals have been isolated from soils. Metallo-organic matter complexes must be identified and characterized before unequivocal evidence for their formation in soils can be obtained. (Auth)

<844>

Mortensen, J.L., and E.C. Marcusiu, Fission Product-Soil Organic Matter Complexes. I. Strontium 90 (Yttrium 90) in Water Extracts and HCl Hydrolysates of Soil. 1963. Soil Science Society of America Proceedings, 27, 653-656 (Ohio Agricultural Experiment Station, Wooster, OH)

Brookston silty clay loam was incubated with 40 uCi Sr 90 (Y 90) for 60 days and extracted with hot water or hydrolyzed with 6N HCl. The supernatant liquid was centrifuged, concentrated, and subjected to electro-dialysis, dialysis, gel filtration, and paper electrophoresis. Some Sr 90 (Y 90) and organic matter migrated to the anode compartment during electro-dialysis suggesting the presence of low molecular weight, negatively charged Sr 90 (Y 90)-organic matter complexes. Dialysis did not remove all of the Sr 90 (Y 90) from the extracts. Gel filtration separated the extracts into several organic matter containing components and showed that Sr 90 (Y 90) was complexed or held on exchange sites by high molecular weight polymers. Presence of radioactivity in the components was correlated with the presence of polycarbonates. Phenols, α -amino acids and α -keto acids were separated from the 6N HCl hydrolysate by paper electrophoresis but no clear correlation between these components and radioactivity on the paper strips was obtained. (Auth)

<845>

Mortensen, J.L., E.C. Marcusiu, and M. Holowaychuk, Strontium Exchange Characteristics of Soils from the Ogotoruk Creek Watershed in Alaska. 1963. Ohio Journal of Science, 63, 225-231 (Ohio State University, Agricultural Experiment Station, Department of Agronomy, Columbus, OH)

The adsorption characteristics of soils from the Ogotoruk Watershed area in Alaska were evaluated. Soil organic matter was extracted from some of the soils with dilute HCl, and it was postulated that complexed strontium 90 was present in these extracts. (CWF)

<846>

Morton, R.J., and E.G. Struxness, Ground Disposal of Radioactive Wastes. 1956. American Journal of Public Health, 46, 156-163 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

The concept and problems associated with disposal of radioactive wastes in soil systems are presented. (CWF)

<847>

Mostafa, I.Y., and A. Hassan, Translocation of Strontium 90 within Pumpkin Plant after Seed and Foliar Contamination. 1964.

Naturwissenschaften, 51, 483 (Atomic Energy Establishment, Department of Biology, Dokki, Cairo, United Arab Republic)

The translocation of Sr 90 within pumpkin plants (CUCURBITA PEPO) was studied by soaking seeds in a carrier-free solution of Sr 90 Cl₂ (4 uCi/ml) for 3 hr or by spraying the foliage of 14-day-old plants with the same radioactive solution. The plants were allowed to grow for 9 weeks and samples collected at different growth ages. For soaked seeds the specific activity of the shoot system was almost constant from the fourth week on but the specific activity of the roots increased. After foliar contamination the total radioactivity retained in the foliage and root remained more or less constant, whereas the specific activity decreased from week to week. There was very little Sr 90 activity in the root. (NSA)

<848>

Mott, C.J.B., and F.H. Wye, Contribution of Adsorbed Strontium to Its Self-Diffusion in a Moisture-Saturated Soil. 1968. Soil Science, 105, 18-23 (University of Oxford, Soil Science Laboratory, Parks Road, Oxford, England)

Self-diffusion coefficient of Sr (+2) ions in a soil indicated that the mobility of ions in the soil was very small and consequently was more related to diffusion on the solid surface rather than within the diffused double layer. (CWF)

<849>

Mouat, M.C.B., Interspecific Differences in Strontium Uptake by Pasture Plants as a Function of Root Cation-Exchange Capacity. 1960. Nature, 188, 513-514 (Department of Scientific and Industrial Research, Grasslands Division, Palmerston North, New Zealand)

Data is presented which indicates that the exchange reactions on the root surface determine the ratio of divalent to monovalent cations adsorbed by the plants. (CWF)

<850>

Muchin, I.E., Content of Radium 226 in the Environment, Foodstuffs and Bones of Ukrainians. Not given. AEC-tr-7214; p. 308 (Not given)

It was determined that the concentrations of Ra 226 in soils and drinking waters vary considerably. Maximum concentrations of Ra 226 are found in breaks and outcrops of igneous rock into the surface. The average concentration of Ra 226 in soil is 150-970 pCi/kg in the acid soluble form and 2650 plus or minus 540 pCi/kg total. The concentration of Ra 226 in drinking water for population varies within the limits of 2 plus or minus 1 X 10⁻¹³ to 28 plus or minus 12 X 10⁻¹² Ci/l. In connection with this the average daily intake of the Ra 226 with water and foodstuffs to the population is equal to 3.5 pCi/gram of Ca. The accumulation of Ra 226 in bone is equal to 105 plus or minus 26 pCi/skeleton. The accumulation factor is thus equal to 35 plus or minus 13. The skeleton contains about 85% of all the Ra 226 which is the adult body. (Auth)

<851>

Hudd, R.D., D.B. Cearlock, and A.E. Reisenauer, Analysis of Hydrological Factors Influencing the Gable Mountain Irrigation Project. 1970. BNWL-1502; 11 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

<851> CONT.

An analysis of the hydrological effects of continued long-range irrigation north of Gable Mountain on the chemical processing area waste management practices at Hanford, Washington are presented. Hydrological factors of the Hanford Reservation were evaluated as influenced by the operation of the Gable Mountain Irrigation Project. The study results indicate that there would be no significant hydrologic effect on the current chemical processing waste management practices. Changes in the groundwater piezometric surface were extremely small and generally confined to the irrigated area. The maximum area that could be irrigated safely was not determined nor was the maximum permissible application rate. Although an irrigated area of about 11,000 acres was studied the results indicate a much larger area could be safely considered. (Auth)

<852>

Muennich, K.O., W. Roether, and L. Thilo, Dating of Groundwater with Tritium and Carbon 14. 1967. CONF-6611301133; STI/PUB-141; Part of Proceedings of a Conference on Isotopes in Hydrology held in Vienna, Austria, November 14-18, 1966, (p. 305-320), 740 p. (University of Heidelberg, Heidelberg, German Federal Republic)

Shallow groundwater can be dated with some accuracy on the basis of its bomb tritium content if the unsaturated soil cover and the aquifer itself is sufficiently homogeneous. A few examples from the Rhine valley are presented. The decrease in tritium level from the water table to a few meter below is nearly two orders of magnitude. Agreement between the measured or estimated variation of bomb tritium in rain during the past decade and the tritium found in shallow groundwater can be obtained if one takes into account that (a) practically no summer rain reaches the water table, and (b) water is mixed by diffusion. Both effects can also be observed in the soil moisture of the unsaturated soil above the water table. Carbon 14 increase in groundwater due to bombs is delayed compared to tritium, the reasons being delay in the biological system and exchange with the carbonate in the soil. Nevertheless lysimeters show a marked increase of carbon 14, which depends on the plant cover, being high in a plant-covered lysimeter and low in a bare one. A simple model is presented, which allows the evaluation of the influence of exchange on the carbon 14 age obtained. It turns out that the deviation from the true age depends on the ratio of the carbonate content in the aquifer material to the carbonate content of the water, on the specific contact surface or the grain size but not on the groundwater velocity. On the basis of this model the experimental finding that carbon 14 ages are usually in agreement with other age estimates despite the loss by exchange is plausible owing to the fact that only material of sufficiently coarse grain size can make up a reasonable aquifer. Assuming only exchange with a monomolecular surface layer of the carbonate grains one finds that the carbon 14 age is likely to differ by not more than a factor of two in the most unfavourable case. Under natural conditions (steady state of cosmic-ray-produced carbon 14) the carbon 14 content of shallow groundwater is hardly influenced at all by exchange, even within very finely grained soil. In the case where the carbon 14 level is rising because of bomb testing, a new equilibrium with the monolayer must be established, by which the carbon 14 increase in groundwater is delayed. The extent of carbonate exchange has been studied

under laboratory conditions in a column. The delay of the carbon 14 pulse in spiked water under the conditions chosen is such that the spike travels with approximately half the velocity of the water. From this and from the dispersion observed one can conclude that equilibrium with the surface monolayer is reached within a few hours. Further studies at elevated temperatures indicate the extent to which penetration into deep layers must be taken into account. (Auth)

<853>

Mukhin, I.E., Zh.K. Pavlova, and L.I. Naqovitsina, Dependence of Radium Content in Vegetables and Cereal Crops on its Concentrations in Soils. 1965, February. Vop. Pitaniya, 24(2), 11-14

Figures showing estimation of the radium 226 content in vegetables and cereal crops grown in soils containing different amounts of this radio- element are presented. The accumulation of radium in vegetable foodstuffs was noted to be contingent not only upon the radium 226 concentration in the soil, but also on the physical and chemical properties of the latter. This point will be the object of further investigations. (Auth)

<854>

Muminov, M.M., and U. Maksudov, The Radioactivity of Grain-Leguminous Plants. 1969. Izv. Akad. Nauk Uzb. SSR, Ser. Fiz-Mat. Nauk, 2, 75-77

The beta and gamma radioactivity of cereal and leguminous plants was investigated. The activity in leguminous plants was several times greater than than in cereal plants. Calcium 48 and K 40 were identified as sources of the natural radioactivity. (NSA)

<855>

Murphy, W.S., A.H. Hunter, and P.F. Pratt, Absorption of Rubidium by Plants from Solution and Soils. 1955. Soil Science Society of America Proceedings, 19, 433-435 (Ohio Agricultural Experiment Station, Wooster, OH)

The absorption by plants of Rb from soils and sand was measured. The Rb was added to the soil as RbCl, and in the sand culture various ratios of K to Rb were used. Corn was grown in the soils and the distribution in the plant and the soil determined. Beans were grown in the culture solutions, and the distribution of K and Rb measured in the various plant parts. The percent recovery of Rb by the corn plant from three soils was inversely related to the K in the soil. The K to Rb ratios in the plants showed high correlation with the HNO₃-soluble K. The percent of the added Rb fixed against extraction with NH₄OAc or HNO₃ during the 11 weeks growing period was small. Where bean plants were grown in sand culture with various ratios of K and Rb, the molar ratios of K and Rb in the plants differed somewhat from those in the solutions. There was also a significant difference between the K/Rb ratios in the various plant parts. Growth and fruit production in beans were reduced where the molar ratios of K to Rb were less than 5/1. (Auth)

<856>

Murmann, R.P., R.W. Winters, and T.G. Martin, Determination of Trace Elements in Soils and Clay Minerals by Resonance Neutron Activation Analysis. 1971. Soil Science Society of America Proceedings, 35, 647-652 (U.S. Army Cold Regions Reservation and Engineering Laboratory, Hanover,

<856> CONT.
NH)

Bentonites 23 and 25, Umat bentonite, Kaolinite 7, Halloysite 29, Illite 35, and Fairbanks, Barrow, and Suffield silts were irradiated with resonance neutrons by exposure of cadmium shielded samples in a reactor for 40 hours in order to identify the elements having long half-life nuclides which could be quantitatively determined using nondestructive neutron activation analysis. By examination of the gamma-ray spectra obtained using a high resolution Ge(Li) detector, it was possible to identify Fe, Ti, Zn, Ni, Co, Cr, Sr, Ba, Cs, La, Eu, Tb, Hf, Ta, Th, and U in most of the samples. Although quantitative results were obtained only for Fe, Ti, Zn, Ni, Co, and Cr, this method appears suitable for nondestructive quantitative analysis of all the elements identified. (Auth)

<857>

Myers, G.E., and G.E. Boyd, A Thermodynamic Calculation of Cation Exchange Selectivities. 1956. Journal of Physical Chemistry, 60, 521-529 (Oak Ridge National Laboratory, Chemistry Division, Oak Ridge, TN)

A complete and thermodynamically rigorous computation of the selectivity coefficients, D , shown by various cross-linked sulfonated polystyrene cation exchangers in the exchange of hydrogen, lithium, potassium and cesium ions with sodium ion was carried out using the Gibbs-Donnan equation. Exact evaluations of the osmotic free energies and of the activity coefficient ratios for the exchangers were performed using cross-differentiation relationships which are valid for ternary mixtures. A comparison of experimentally determined D values with those computed showed a general agreement with the errors involved. However, significant discrepancies were found with the more highly cross-linked exchangers. The important conclusion was drawn that cation exchanger prepared by the sulfonation of polystyrene-divinylbenzene copolymers are chemically heterogeneous in that more than one type of ionogenic group may be present in their structure. (Auth)

<858>

Myhre, D.L., R.G. Menzel, H. Roberts, Jr., M.H. Frere, M. Aemiva, O.W. Beale, D.R. Timmons, and E.H. Wood, Reduction of Strontium 90 Uptake by Corn and Soybeans with Deep Placement, Irrigation, and Soil Amendments. 1964. Agronomy Journal, 56, 463-467 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Beltsville, MD)

Field experiments were initiated in 1960 in the states of Georgia, South Carolina, Iowa and Minnesota to evaluate methods of reducing uptake of Sr 90 fallout by crops. Significant reductions in Sr 90 content in corn and soybean grain were obtained by deep placement but not by irrigation. Calcium treatments reduced Sr 90 in both grains in Georgia, and potassium reduced Sr 90 in corn grain in Minnesota. The maximum reduction observed was about 50 percent. (Auth)

<859>

Myttenaere, C., Effect of the Strontium-Calcium Ratio on the Distribution of Strontium and Calcium in PISUM SATIVUM. 1964. Physiologia Plantarum, 17, 814-827 (Euratom, Service de Biologie de la Direction Recherches et Enseignement, Mol, Belgium)

The physiological distribution of Sr and Ca is a function of the Sr/Ca ratio in the nutrient solution. The lower the Sr/Ca ratio is, the higher is the quantity of Sr fixed on the walls. The proportions of Ca and Sr found in the cell walls and in the cell sap are equal when ratio in the nutrient solution is one. In the walls part, Sr is not only chemically fixed (pectate i.e.) but a certain fraction is exchangeable. As previously reported for Ca, these results would confirm the theory of the translocation of Sr by exchange. The discrimination made by animals between Ca and Sr could partly be due to the ingested plant material (passive discrimination) and to the animal (active discrimination). (tr-Auth)

<860>

Myttenaere, C., Absorption of Cobalt by Irrigated Rice: Influence of the Concentration in the Nutritive Environment and of the Chemical Form of the Cobalt. 1970. CONF-690918-(Vol. 2); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 895-906), 506p. (Euratom, Ispra, Italy)

Indirect contamination (soil and irrigation water) is responsible for an appreciable fraction of the radioactivity of rice plants harvested in irrigated rice fields. The irrigation water has proved to be a much more important contamination factor than the soil, and the transfer factors obtained between water and plants are identical with those observed in crops grown in solutions. Co 60 is one of the main radioisotopes discharged into Lake Major by the Ispra Center, the water of this lake being used for the irrigation of various crops (by spraying and flooding) including irrigated rice. A first experiment was carried out by aquiculture on gravel to study the influence of the dose and chelation of the Co in the nutritive environment on the Co 58 content of various organs of the plant. No significant reduction in yield and no symptom of toxicity were observed for the concentration range considered (0 to 5 ppm). The specific activity of the whole plant expresses an absorption proportional to the amount of Co present in the nutritive medium. However, the smaller this quantity the more the Co is fixed in the region of the roots, while the opposite phenomenon is observed for the aerial part of the plant. The transfer factor varies according to the organ in question and is close to unity for the endosperm. The chelation of cobalt appreciably reduces the activity levels of the various organs analyzed. Under the experimental conditions, the Fe and Mn contents of the plants are not a function of the stable Co concentration of the medium and consequently of the plant. The use of chelated Fe no doubt greatly reduced the influence of Co. From a health point of view the consumption of rice as a staple food seems to pose no serious problem. (Auth)

<861>

Myttenaere, C., Influence of the Strontium-Calcium Ratio on the Growth and Absorption of Strontium and Calcium in PISUM SATIVUM L. 1963. Ann. Physiol. Vegetale 1'Univ. Bruxelles, 8, 47-60 (Euratom, Service de Biologie de la Direction Recherches et Enseignement, Mol, Belgium)

A test was carried out to study the influence of the Sr/Ca ratio on the growth, absorption and concentration of calcium and strontium in PISUM SATIVUM L. Activation analysis was used

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for determining the Sr contents of the different parts of the seeds used. Half the average quantity of Sr in a seed was concentrated in the spermoderm. Comparable results were obtained for calcium. (tr-Auth)

<862>

Myttenaere, C., The Influence of the Strontium/Calcium Ratio of the Nutrient Solution on the Translocation and Chemical Forms of Strontium and Calcium in *PISUM SATIVUM*. 1965. Radiation Botany, 5, 143-151 (Euratom Biology Services, Research and Training Division, Centre d'Etudes Nucleaires, Mol, Belgium)

The effect of the strontium/calcium ratio of the nutrient solution was studied under controlled conditions in *PISUM SATIVUM*. The nutrient solutions varied in their Sr/Ca ratio whereas the sum total of strontium and calcium was maintained at 5 m-equiv./l. Translocation rates, concentration factors as well as the chemical forms of strontium and calcium were studied. The results indicate a different distribution of strontium and of calcium in the shoot and in the roots depending upon the Sr/Ca ratio of the nutrient solution. For a very low ratio (as occurs in soil, taking into account the greater retention of strontium than of calcium by the substrate and the amounts generally present) the calcium content of the shoot increases more rapidly than that of strontium. In this case the concentration factor for strontium is greater in the roots than in the shoot. When the Sr/Ca ratio increases the reverse is eventually obtained. A low Sr/Ca ratio results also in a different chemical distribution of these elements. The lower the concentration of strontium in the nutrient solution the greater is the fraction soluble in $\text{HCl } 2 \text{ N}$. The distributions of calcium and strontium are clearly different for a lower Sr/Cr ratio. (Auth)

<863>

Myttenaere, C., and P. Bourdeau, Cesium 137, Stable Cesium and Potassium in Lowland Rice. 1969. CONF-670503; Part of Nelsca, D.J. and Evans, P.C. (Eds.), Proceedings of the Second National Symposium on Radioecology, held in Ann Arbor, Michigan, May 15-17, 1967, (p. 553-560), 774p. (Euratom Joint Research Center, Biology Service, Ispra, Italy)

Stable cesium, potassium, and Cs 137 from fallout were measured in lowland rice grown in 1964 near Vercelli, Italy. No correlation was found between the Cs and K contents of various plant parts. Flooding enhanced the uptake of stable Cs in the shoots. It also increased the specific activity of Cs 137 (pCi Cs 137 per microgram stable Cs) in the plant. (Auth)

<864>

Myttenaere, C., and P. Bourdeau, Relative Importance of Soil and Water in the Indirect Contamination of Flooded Rice with Radiocesium. 1969, June. Health Physics, 16, 701-707 (Euratom, Ispra, Italy)

The relative importance of soil and water in the indirect contamination of flooded rice with radiocesium was investigated in model rice fields, using a double tracing technique. Roots were found to contain relatively much more Cs 134 (coming from the soil) than Cs 137 (from the water), whereas the reverse was true for the other plant parts and especially for the carvopis. Further experiments are needed to explain this lack of isotopic equilibrium within the plant. Flooded rice absorbed 30 to

100 times more Cs from the water than from the soil. The Cs 137 activity of the plants was related to the average activity of the water, both in time and in space. At the end of the experiment (13 weeks) the soil of the 5 plots had fixed from 41 to 64% of the Cs 137 brought with the water. Concentration factors between plant and water were quite similar to those observed in nutrient solution culture, which confirms the importance of water as a vector of Cs contamination to flooded rice. The upper layer of soil was depleted in Cs to a much greater extent by the surface roots than the lower layers by the normal root system. (Auth)

<865>

Myttenaere, C., P. Bourdeau, and R. Bittel, Relative Importance of Water and Soil in the Indirect Radiocesium and Radiocobalt Contamination of Irrigated Rice Fields. 1969. STI-PUB-226; CONF-690317; Part of a Seminar on Agricultural and Public Health Aspects of Environmental Contamination by Radioactive Materials, held in Vienna, Austria, (p. 175-182) (International Atomic Energy Agency, Vienna, Austria)

Tests involving models of irrigated rice fields with double labeling for each element have shown that transfer to the plant from water is much greater than from the soil (by a factor of 7 to 12 in the case of cobalt and 30 to 100 in that of cesium). The water-plant transfer rates are comparable to those obtained in aquiculture. The soil fixes the two elements strongly. EDTA reduces radioactive cobalt fixation and its absorption by the plant, thus leading to transport of the contamination over a greater distance. (Auth)

<866>

Myttenaere, C., and R. Kirchmann, Influence of the Application of Stable Strontium to Soil on the Content of Strontium in Cultivated Vegetables. Use of Activation Techniques and Gamma Spectrometry. 1962. Physiologia Plantarum, 15, 656-662 (Centre d'Etudes de l'Energie Nucleaire, Mol, Belgium)

Determination of the amount of stable strontium in *LOLIUM ITALICUM* and *TRIFOLIUM PRATENSE* grown on poor soil enriched by stable strontium (3 and 7.5 g/m²) is described. In case of Sr-rich specimens, the determinations may be done on basis of the Strontium 85 measurements without thorough chemical separation. For Sr-poor specimens, the described separation technique allows the Sr 87m measurement. The adsorption of Sr, sprayed on the soil surface, is a function of the depth of roots. The soil labour during the second season allowed the *TRIFOLIUM PRATENSE* to adsorb more intensively the Sr, added in the first season. The supply of a small quantity of stable Sr modifies the Ca amount of the vegetables. (Auth)

<867>

Myttenaere, C., R. Kirchmann, X. Dalschaert, M. Debot, and E. Fagnart, Absorption and Localization of Strontium and Calcium in Plants. 1965. EUR-487.f(Vol. I); 20 p. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium)

The effect of the Sr/Ca ratio in the nutrient solution was studied in *PISUM SATIVUM*. The ratio was varied while the sum of the two ions was maintained constant at 5 uq/l. The amount of stable Sr in the seed was determined by radioactivation (0.5 micrograms per seed). More than half of this amount was localized in

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the spermoderm. Such a result was also found for calcium. The substitution of Ca by Sr reduces the growth of PISUM; however, a partial substitution (1/100 of the total Ca(+2) and Sr(+2)) was beneficial. The observed ratio is not a constant and varied with the organ and the Sr/Ca ratio of the nutrient medium. At very low Sr/Ca ratios, as in soil, taking into account the low Sr concentration and its high retention, the amount of Sr in the shoot is lower than in the roots. Higher Sr/Ca ratios give opposite results. A low Sr/Ca ratio results also in a different chemical distribution (percent) of the absorbed Sr and Ca. The discrimination made by animals between Sr and Ca could be partly attributed to the quality of the ingested plant material. (Auth)

<868>

Myttenaere, C., and M. Masset, Availability of Stable Manganese and Magnesium 54 to the Rice Plant in Flooded Soil. 1969, April. Soil Science, 107, 296-301 (Euratom, Ispra, Italy)

Rice was grown in a flooded soil traced with Mn 54 and sampled throughout the growing cycle in order to explain variations in the specific activity of this radioelement within the plant and relate them to the availability of stable and radiomanganese in the soil. The specific activity of Mn 54 in the plant was found to decrease with time together with that of the available Mn fraction of the soil. At harvest, the differences observed within the plant were related to the time at which the organs developed and to their function. These differences may be explained by the evolution of the isotopes in the soil and by the low mobility of Mn in the plant. The values obtained for the total aerial part represent an integral of the conditions prevailing during the whole growing cycle and are consequently higher than the roots values. (Auth)

<869>

Myttenaere, C., and M. Masset, Distribution of Strontium and Calcium in PISUM SATIVUM in Relation to the Strontium/Calcium Ratio of the Culture Fluid. 1965. Ann. Physiol. Veg., 7, 97-104 (Euratom, Ispra, Italy)

Pea (PISUM SATIVUM, var. Espoir de Grembloux) seedlings were grown in nutrient fluid containing Sr and Ca in three different proportions, along with tracer amounts of Sr 85 and Ca 45, and analyses for the two elements were made in various plant parts after different growth intervals. Thus, the absorption and distribution of Sr and Ca were investigated for three Sr/Ca ratios of the nutrient solution: 0/5, 0.5/4.5, and 2.5/2.5 meq/l. The stable Sr content of the aerial parts and the roots increased with the Sr/Ca ratio of the nutritive solution. Examination of the variation of the ratio of Sr content in the aerial parts and the roots (mg/g dry matter) revealed a greater retention of Sr at root level for a low Sr/Ca ratio; a similar investigation carried out for Ca showed a different behavior for the two ions. The major part of Sr and Ca in the tissues can be extracted by hydrochloric and perchloric acids. The lipid, nucleic acids, and residual components contain little of these elements. The fraction containing the pectates varied in content according to the Sr/Ca ratio of the nutrient solution and with the element assayed. The results illustrate the caution needed in examining the metabolism and tissue distribution of Ca and Sr; they show that the

two elements are not handled physiologically by the plant in an identical way. (NSA)

<870>

Myttenaere, C., and M. Masset, Cesium 137 and Strontium 85 Uptake by Irrigated and Mountain Rice: Study of the Relative Importance of Plant Variety and Culture Medium. 1966. IAEA/SM-77/7; CONF-660912-3; Part of Proceedings of the FAO/IAEA Symposium on the Use of Isotopes in Plant Nutrition and Physiology Studies held in Vienna, Austria, September 5-9, 1966 (Euratom-CCR, Ispra, Italy)

The influence of the nutrient medium and plant variety on the uptake of Cs 137 and Sr 85 by rice was studied in two varieties (irrigated and mountain). The plants were grown in nutrient solutions with Cs 137 and Sr 85 added and in soil irrigated or surface-treated with the nutrient solutions. The effects of the NH₄, K, and Ca content of the nutrient solution on the uptake of Cs 137 and Sr 85 was also studied. After cultivation the plants were analyzed for the content of Cs 137, Sr 85, and stable elements in the various plant parts (roots, stems, and seed). Soil samples taken at various times during growth of the plants were also analyzed. Results showed that the nutrients in the medium, particularly the NH₄ ion, influenced the uptake of both Cs 137 and Sr 85 by rice. A marked difference in the uptake and distribution of the two isotopes in the two varieties was also found. Plants harvested from irrigated soil showed the greatest uptake of Cs 137. (NSA)

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Myttenaere, C., and M. Masset, Etude Comparative de l'absorption du Strontium et du Calcium Chez le Riz Irrigue en Fonction des Teneurs et des Rapports Strontium/Calcium de la Solution Nutritive. 1971. Radioprotection, 6, 209-215 (Euratom-CCR, Biology Division, Ispra, Italy)

From a physiological point of view, a study has been made of how and to what extent strontium and calcium are discriminated as a function of the two variables, the strontium to calcium ratio and the total amount of strontium and calcium in the nutrient medium. A factorial study in water culture condition has shown that the observed ratio was a function of the both variables. As it flows up the mineral sap gets progressively poorer in strontium and the conducting organs are relatively richer in strontium than the leaves and grains are. The observed ratios obtained for the caryopse are well lower than 1, which demonstrates a relatively larger amount of calcium. (Auth)

<872>

Myttenaere, C., and J.M. Mousny, Influence of the Quality of the Irrigation Water on the Transfer of Radiocesium and Radiostrontium in Irrigated Rice-Fields. 1972. EUR-4800; Part of Proceedings of an International Symposium on Radioecology Applied to the Protection of Man and His Environment held in Rome, Italy, September 7, 1971, (p. 1255-1275) (Euratom, Ispra, Italy)

Study of the mechanisms of radiocontamination in rice-fields irrigated by submersion of the soil has emphasized the importance of the irrigation water in the transfer of the various radioelements considered (Cs, Co, and Ru). These unstable isotopes can be absorbed directly by the base of the hauls and the surface roots or may be previously fixed by the surface layer of the soil and then reabsorbed by the roots. Under such

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conditions, it was of interest to be able to assess the influence of the chemical properties of the water used on the level of radiocontamination of the plants, the fixing of the radioisotopes by the soil, and the elimination by the irrigation water. This problem was tackled in a "rice-field model" in which three different waters were considered: very pure (demineralized), Lake Maggiore (20 ppm Ca, 1.5 ppm K, 0.2 ppm Sr) and "charged" (100 ppm Ca, 5 ppm K, and 1 ppm Sr). These waters were doubly marked with Sr 85 and Cs 134. During cultivation, samples of the water covering the ricefields were taken regularly and at the end of cultivation plants and soils were sampled. The concentrations of radioelements and stable elements in the samples were determined. These results not only make it possible to establish a relation between the water used and the level of contamination of the irrigated plants, but will also enable the discrimination factors between irrigated water and plants to be calculated. These results are interpreted on a very broad basis including the water, the soil, and the plant. It is already possible to state that the water of Lake Maggiore is responsible for the highest radiocesium contamination (least fixation by the soil, low opposition in absorption). The radiostrontium content is only substantially reduced following irrigation with highly "charged" water. The distribution of the radioisotopes within the plant is also affected by the quality of the water used. The edible part (caryopsis) is the one most contaminated with Cs(+1) and Sr(+2) in the case of a rice-field irrigated with water from Lake Maggiore. (Auth)

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Hyttenaere, C., G. Verfaillie, and P. Bourdeau, Uptake and Distribution of Cesium 144 in ORYZA SATIVA. 1967. CONF-660405; Part of Aberq. B. and Hunkate, R.P. (Eds.). Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, (p. 437-442), 1051p. (Euratom Joint Research Centre, Biology Service, Ispra, Italy)

Rice plants of a lowland variety (Arborio) and a mountain variety (Rikuto Morin I) were grown to maturity in nutrient solution culture and in a soil controlled environment chamber. Cesium 144 was applied to the solution or to the soil surface when the seedlings were established. Cesium 144 levels in the plant parts generally decreased with distance to the root system. Leaves were more active than internodes which were in turn more active than panicles or grains. In nutrient solution culture the average Cs 144 level was twice as great in the lowland as in the mountain variety, mainly because of differences in the activity of the lower plant parts. The ratio of Ce 144 levels in hull and in hulled grain was 8.2. In both varieties, the roots contained 99.50 percent of the activity, the shoot 0.49 percent and the panicle 0.01 percent. In soil culture the Ce 144 levels in the plants were much lower than in solution culture, except in the endosperm for which the concentrations observed were very low in both cases. The ratio of Ce 144 in hull and in hulled grain was 1.6 in lowland and 2.3 in mountain rice. For the lowland variety grown in flooded soil, 86.3 percent of the absorbed Ce 144 was in the roots, 13.4 percent in the shoots and 0.3 percent in the panicle. For the mountain variety grown in soil kept at field capacity, the corresponding percentages were

96.4, 3.4 and 0.2, respectively. The differences in the distribution of Ce 144 between varieties were mainly due to lower concentration in plant bases and old leaves in the lowland variety. Thus, in flood culture a greater fraction of the absorbed Ce 144 goes to the shoot, which agrees with field observations on level of Ce 144 from fallout. However, the cerium content of the endosperm seems to be little affected by variety and growing conditions. (Auth)

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Nafady, M.H., and C.G. Lamm, Plant Nutrient Availability in Soils. IV. Studies on the Role of Copper in Danish Soils. 3. The Exchange Properties with Particular Reference to Fixation and Release Processes. 1971. CONF-711213; IAEA/SM-15/42; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships, Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971 (Technical University of Denmark, Chemistry Department, Lyngby, Denmark)

The examined soils obey the Ratio Law for the ion pair Cu-(Ca(I)Mg). The copper equilibrium activity ratio has the same value regardless of Ca concentrations up to 9.05 moles per liter and soil solution ratios (1:10 - 1:40). Thus the value of the copper equilibrium activity ratio of a given soil can be taken as a measure of its availability or intensity. The copper O/I relations exhibit two parts, a) a curved lower part and b) a linear upper part. The slope of the upper part can be used as a tool for the capacity factor, i.e. Copper Potential Buffering Capacity (PBC(Cu)). The value of the lower part can be used as a crude measure of the number of sites holding Cu tightly e.g. exchange sites and complexing sites. Most of copper added to the soil was fixed by air-drying. Extraction by 0.1 M HCl for several times did not recover more than 72 percent of the added Cu. The steady rate of release of the fixed copper is very low, indeed, compared to soil potassium. (Auth)

<875>

Nakhla, S.M., and G. Delbrias, Use of Carbon 14 of Thermonuclear Origin to Study the Dynamics of Carbon in the Soil. 1967. STI/PUB-152; CONF-570309; Part of IAEA Symposium on Radioactive Dating and Methods of Low-Level Counting held in Monaco, France, Mar. 2-10, 1967, (p. 167-176) (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Saclay, France)

The nuclear explosions which have taken place in recent years have given rise to a considerable increase in the specific activity of carbon in the atmosphere and in the biosphere. The organic matter in soils which is derived from plant debris of every kind, leaves, dead branches and radicles, is thus slowly being labelled with this artificial radioactivity. It is therefore possible to use the variations in carbon specific activity to follow the different stages in the transformation of plants in the soil. The study was made on forest soil at the edge of a thinly planted wood of chestnut trees in the Paris region, and was begun in 1964. The C 14 measurements deal principally with decayed plant matter, the humic acids, which are soluble in alkaline reagents and can be precipitated by sulfuric acid, and the humin, which is the insoluble organic part of the alkaline reagents. In this way it has been possible to show that in this soil humin is an intermediate stage in the transformation of plant matter into humic acids, and that in every case it is more contaminated with

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artificial C 14 than are the humic acids. The time which passes between the falling of the leaves and the formation of humic acids, the final stage in the transformation of organic materials, has been found to be between four and five years, while the duration of the decomposition of a leaf into humin is about 25 years. It has also become apparent that in the layer of soil immediately above the mother-rock, the specific activity of the humic acids was not affected in 1965 by the increase due to artificial C 14, which suggests that the transport time of these acids from the surface is more than 12 years. (Auth)

<876>

Naryshkin, M.A., R.M. Aleksakhin, and M.N. Mishenkov. On the Migration of Strontium 90, Ruthenium 106, Cesium 137 and Cerium 144 of the Global Fallout in a Forest Biogeocoenosis. 1973. *Lesovedenie*, 3, 10-17 (Not given)

Content of Sr 90 and Cs 137 in 1970 in a 27 year old birch forest was equal to 92-94.5% in the soil, 2.8-3.6% in the forest litter and 2.8-4.3% in the overground phytomass from the total stock of these radionuclides in the biogeocoenosis. Concentrations of Sr 90 and Cs 137 in different parts of birch and pine exposed to fallout were lower in 1970 as compared to 1964 by a factor of 3 to 10. Coefficients of aerial sorption of Ru 106, Cs 137 and Ce 144 by arboreous plants are calculated. (Auth)

<877>

Mavrot, J., B. Jacoby, and S. Ravikovitch. Fixation of Zinc 65 in Some Calcareous Soils and Its Availability to Tomato Plants. 1967, August. *Plant and Soil*, 27, 141-147 (Hebrew University, Rehovot, Israel)

Binding of Zn 65 in two calcareous surface soils was examined, namely in a loess soil derived from desert dust material originating partly from carbonaceous rocks, and a rendzina formed on mail. Marmande tomatoes (*LYCOPERSICON ESCULENTUM*) were used as test plants to determine Zn 65 availability. Zinc 65 fixation was very rapid and almost complete in both soils. Most of the Zn 65 was fixed in the uppermost layer of soil columns: Zn 65 penetration was somewhat deeper into the loess with the lower CaCO₃ content than into the rendzina. Zinc 65 availability was, however, higher in the rendzina than in the loess soil either determined by uptake by tomato plants or by extractability. Possible reasons for the differences in Zn 65 availability in the two calcareous soils were discussed in terms of the different solubility of Zn 65 in the two calcareous soil types. The cause could be related to differences in the nature of fixed Zn formed, perhaps in relation to the specific surface of ZnCO₃ particles. (NSA)

<878>

Nelson, J.L., W.A. Haney, K.C. Knoll, and D.W. Bensen. Laboratory, Pilot and Field Scale Studies of Fission Product Migration Rates in Soils. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Richland Laboratories, Hanford, WA)

Methods for using laboratory data to predict field situations were evaluated with data from a study of the factors that affect the migration of strontium in soil columns. A

model disposal crib was used to evaluate the applicability of extrapolation methods. Planned experience in ground disposal has also provided opportunities for correlating laboratory data with field movement rates. These studies have shown that laboratory soil column data can be used to provide good estimates of actual migration rates in the field. (Auth)

<879>

Neuburger, M., and A. Fourcy. Study of Ruthenium Partition in an Ecological Pond using Neutron Activation Analysis. 1969, September. *Int. J. Appl. Radiat. Isotop.*, 20, 641-651 (Laboratoire de Biologie Vegetale, Centre d'Etudes Nucleaires de Grenoble, Commissariat a l'Energie Atomique, Grenoble, France)

Ruthenium is one of the components of radioactive wastes issuing from nuclear experimentation. As ruthenium radioisotopes show the same biological behavior as stable ruthenium, it was suggested to study the partition of a low intake of nonradioactive Ru in an ecological pond which was initially nearly free of natural Ru. For this purpose, water, sediments, aquatic and semi-aquatic plants are periodically taken off and analyzed using neutron activation analysis. (Auth)

<880>

Mevin, R.L., Redistribution of Radiocontaminants by Surface Water Flows. Preliminary Study. 1964, June 22. HMS-1229-46; 31 p. (Bradberry (Carroll E.) and Associates, Inc. Los Altos, CA)

A preliminary study was made of the potential for redistribution of radiocontaminants in a fallout area by surface water flows. The processes of transport and accumulation of radioactive material were investigated, and the capability for accurate hazard appraisals with present knowledge evaluated. Primary consideration was given to the problems that may be encountered in areas where useful applications of nuclear energy may be proposed in the future rather than the situations at test sites selected for their isolation and favorable climates. It was concluded that the mechanism for significant redistribution and concomitant contamination of water supplies probably will exist in some areas, but that present knowledge of erosion, sedimentation and the hydrochemical processes is insufficient for accurate predications. It was concluded also that widely distributed deposits of contaminated particulate material could be accumulated by the processes of erosion and sedimentation and create long-term, continuing sources of contamination to water supplies. Further studies are recommended, including experimentation on the leaching, erosion and sedimentation of dissolved and adsorbed radionuclides. (Auth)

<881>

Newbould, P., Relationship Between Isotopically Exchangeable Calcium and Absorption by Plants. 1963. *J. Sci. Food Agr.*, 14, 311-319 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

When soils are suspended in solutions of calcium chloride labelled with radioactive tracer, isotopic exchange with the labile soil-calcium occurs rapidly. This may be followed by a slow secondary exchange reaction, but its magnitude is not great and equilibrium is nearly, if not completely, attained within 7 days. When, however, plants are grown in soil throughout which

<881> CONT.

carrier-free calcium 45 has been thoroughly mixed, the Ca 45 absorbed by the plants equilibrates with a quantity of soil-calcium larger than that which undergoes isotopic exchange when soils are suspended in solutions of labelled calcium chloride. The analysis of plants grown for varying periods shows that equilibration can continue for several weeks, and that the quantity of soil-calcium with which the Ca 45 is associated can be increased by growing plants under exhaustion conditions. In five soils, the extra calcium which equilibrated with Ca 45 in this way never exceeded 3.5 percent of the total soil-calcium, and was usually considerably lower. The continued equilibration of Ca 45 with soil-calcium causes the specific activity (Ca45/stable Ca) of the calcium entering plants to decrease. Because the calcium in plant roots has, on average, been absorbed more recently than that in shoots, the latter show higher specific activities. The causes of these effects are discussed, and their significance in the interpretation of results of experiments which involve the use of Ca 45 as a tracer in research work on soil/plant relations is considered. (Auth)

<882>

Newbould, P., J. Sanderson, M.G.T. Shone, and G.H. Sidrak, Uptake of Potassium and Rubidium by Barley and Pea Plants. 1964. ARCRL-12: (p. 56-58) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Experiments were carried out on two soils and two crops supplied with varying quantities of potassium and rubidium 86 as a tracer to determine the extent to which plants discriminate against rubidium in favor of potassium. The absorption of rubidium 86 and potassium by barley and peas, discrimination factors, and the extent to which potassium initially present in the soil equilibrates with the rubidium 86 in the process of uptake (apparent I -values) are given in tabular form. Comparisons were also made between the amounts of potassium and rubidium which could be extracted from the soils by several solutions. (ST)

<883>

Newbould, P., and H.M. Squire, Strontium 90 in Milk and Agricultural Materials in the United Kingdom 1959-1960. 1961. ARCRL-4: (p. 39-40) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Strontium 90 distribution in some soil profiles appeared to be related more strongly to diffusion mechanisms rather than mass flow transport. (CWF)

<884>

Newbould, P., and R. Taylor, Uptake of Nutrients from Different Depths in Soil by Plants. 1964. ARCRL-12: (p. 51-54) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Absorption of phosphorus and calcium by ryegrass from different depths and the effects of superficial dressing with fertilizer and of frequency of defoliation were studied. Fertilizers depressed the ratio (P/Ca) in which phosphorus and calcium entered plants from 10 cm; defoliation had the reverse effect, particularly later in the season and from the greatest depths. The relative uptake of phosphorus and calcium by potato haulms

from different zones of soil and the absorption of phosphorus from two depths by barley and kale in the presence and absence of fertilizer were also studied. (ST)

<885>

Ng, Y.C., Estimation of the Internal Dose to Man from the Radionuclides Produced in a Surface Explosion of a Nuclear Device. 1968. UCRL-70894; CONF-680507-4; Part of Proceedings of a Conference on Radiological Protection of the Public in Nuclear Mass Disasters held in Interlaken, Switzerland, May 27-June 1, 1968 (University of California, Lawrence Radiation Laboratory, Livermore, CA)

A method was developed for estimating the internal dose to man from each radionuclide that is produced and released to the atmosphere following the detonation of a nuclear device. By means of this analysis the nuclides that could contribute most to the internal dose in man can be identified, the internal dose to tissues and organs of man can be estimated, and contributions of individual nuclides to this dose can be determined. Data are tabulated for: meter 2-rad via milk to the child's whole body and bone from Pu 239 fission products; meter 2-rad via milk to the child's whole body and bone from activation products produced in soil by a surface nuclear explosion; meter 2-rad via soil to the child's whole body and bone from Pu 239 fission products; fractional deposition as a function of post-detonation time; and total estimated dose to the child or infant from a hypothetical 1-Mt surface explosion of a thermonuclear device. The figures indicate that under conditions of normal agricultural practice substantial internal dosages could be experienced at very large distances from the site of detonation. (NSA)

<886>

Nielsen, D.R., and J.W. Biggar, Miscible Displacement. III. Theoretical Considerations. 1962. Soil Science Society of America Proceedings, 26, 216-221 (University of California, Department of Irrigation, Davis, CA)

Several theoretical models are examined as to their usefulness in describing miscible displacement in porous materials. These descriptions are discussed for glass beads, sieved aggregates and soils at several water contents and for several flow velocities. It is shown that mathematical descriptions which do not include individual mechanisms are unsatisfactory. The mechanisms that must be considered are discussed with specific reference to experimental data. (Auth)

<887>

Niemann, E.G., Effects of Artificial Strontium 90 Fallout on Plants. I. Uptake and Distribution of Strontium 90. 1961. Atompraxis, 7, 370-375 (Technische Hochschule, Hanover, German Federal Republic)

Model experiments were made with artificial Sr 90 fallout in order to study its uptake, distribution, and radiobiological effect in a plant over several generations. The plants were raised in postexperiments under defined conditions. The Sr 90 was applied as a solution through special jets in the form of fine precipitation. For most part it was taken up directly into the plant via the leaves. Activity distribution in the soil corresponded approximately to an exponential decrease; a subsequent inactive spraying led to a leveling off in the upper soil layers.

<887> CONT.

The selective enrichment of Sr 90 in the plant material was in no case great enough to provide effective decontamination of the soil through plant growth. (Auth) (CWF)

<888>

Nichtingale, H.I., and R.L. Smith, Evidence for the Presence of Calcium-Organic Complexes in Sodic Soil. 1967. Soil Science, 103, 261-264 (Utah State University, Agricultural Experiment Station, Logan, UT)

The principal conclusions of this study are: 1) sodic soils that have not been leached and contain considerable amounts of dispersed organic material may contain Ca-organic complexes and little free ionic Ca, 2) Consideration must be given to possible complexing of soil Ca by organic material when ion activity calculations are based on ion concentration in water extracts of sodic soils containing dispersed organic material and 3) this study indicated that Ca-organic complexes can influence alfalfa shoot and root development. (Auth)

<889>

Nikol'skii, B.P., Ion Exchange Sorption of Radioelements. 1958. AEC-tr-6631; Russian Journal of Inorganic Chemistry, 3, 88-98

A review is given of the ion exchange and sorption behavior of radioelements. The use of ion exchange in radiochemistry is discussed. (CWF)

<890>

Nishita, H., D. Dixon, and K.H. Larson, Accumulation of Cesium and Potassium and Growth of Bean Plant in Nutrient Solution and Soils. 1962, February. TID-15044; 31 p. (University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

Bean plants were grown to maturity in nutrient solutions and soils to study the influence of Cs and K on the growth and uptake of K, Cs 137, and stable Cs. The application of K to Cs 137-treated soils relatively high in exchangeable K had only slight effect on the plant uptake of Cs 137. Increasing additions of K to Cs 137-treated nutrient solution decreased the uptake of Cs 137. In both soils and nutrient solutions, the application of K increased the K uptake by plants. Small applications of stable Cs to contaminated soils and nutrient solutions caused a greatly increased Cs 137 uptake by plants, presumably a carrier effect. Large applications of Cs reduced the uptake of Cs 137 because of isotopic dilution. Up to a certain threshold level, the plant uptake of K increased with that of stable Cs and appeared to be partly non-competitive with Cs. Bean plants discriminated against Cs. The discrimination between Cs and K varied with K and Cs concentration in the nutrient media. Cesium was toxic to bean plants. This toxic effect was alleviated to some extent by increasing the application of K. In the soils studied, reduction in plant yields occurred when the application of Cs was greater than 8 percent of the soil cation exchange capacity. (Auth)

<891>

Nishita, H., and E.H. Essington, Effect of Chelating Agents on the Movement of Fission Products in Soil. 1967. Soil Science, 103, 168-176 (University of California, Los Angeles, CA)

Chelating agents, ethylenedinitrilotetraacetic acid (EDTA), carboxymethyliminobisethylenetriol tetraacetic acid (DTPA), and ethylenediiminobisohydroxyphenylacetic acid (EDDHA), and deionized water were evaluated as to their ability to move several radioactive fission products (Sr 89, Y 91, Ru 106, Cs 137, and Ce 144) in different kinds of soils. Different soils exhibited considerable difference in the effectiveness of the various leaching agents. Irrespective of the kind of soil, the order of magnitude of movement by water leaching generally was Cs 137, Y 91, Ce 144 < Sr 89 < Ru 106. Except in one soil (Hanford sandy loam), practically no movement of Cs 137, Y 91, or Ce 144 occurred by H2O leaching. Among the chelating agents, the effectiveness of EDDHA was generally the least, while the relative effectiveness of DTPA and EDTA varied with the soil and radionuclide. The possible causes for the variations in the effectiveness of different leaching agents in different soils were discussed. (Auth)

<892>

Nishita, H., and M. Hamilton, Spurious Thermoluminescence of Soils. UCLA-12-757; 21 p. (University of California, Los Angeles, CA)

Spurious thermoluminescence of six soils differing widely in physical and chemical characteristics was examined. As observed by previous investigators working with other materials, the spurious glow of soils also appeared to be dependent on the oxygen adsorbed on the surface of the luminescent particles. The amount of natural spurious thermoluminescence depended on the kind of soil. Spurious (surface) glow and volume glow were increased considerably by exposing the soils to Co 60 photons. The increase of the surface glow relative to that of the volume glow on irradiation depended also on the soil. One soil (Aiken clay loam) examined showed that it is possible to obtain the increase of surface glow on irradiation without the formation of detectable amounts of volume glow. Except for one soil (soil No. 4FF), the volume glow of the soils exposed to Co 60 photons occurred predominantly in the low temperature range (less than 250 degree C), while the surface glow occurred predominantly in the high temperature range (greater than 250 degree C). The large amount of volume glow induced in soil No. 4FF by irradiation appeared to be due to its high lime content. (Auth)

<893>

Nishita, H., and R.H. Haug, Influence of Clinoptilolite on Strontium 90 and Cesium 137 Uptakes by Plants. 1971; 1972. UCLA-12-829; Soil Science, 114, 149-157 (University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

An experiment was conducted to determine the effect of clinoptilolite on the Sr 90 and Cs 137 contents of bean and barley plants grown in soils contaminated at the surface (experiment I). An experiment was also conducted to determine the release of Sr 90 and Cs 137 to clover plants upon continuous and prolonged cropping of a contaminated soil with and without clinoptilolite treatment (experiment II). In experiment I, clinoptilolite was found to decrease the average Sr 90 contents of plants. The percentage reduction of Sr 90 contents of the different parts of the bean plants ranged from 48 to 70, 54 to 77 and 44 to 77 percent in the

<893> CONT.

leaves, stems and fruits, respectively, depending on the amount of clinoptilolite application and the kind of soil. The percentage reduction of Sr 90 in barley plants under various treatments ranged from 57 to 77 and 57 to 79 for the leaves and stems and the heads respectively. In experiment II, eight harvests of clover were obtained. The application of Ca-treated clinoptilolite was effective in reducing Sr 90 contents of the plants grown in the mineral soil used, but it had no effect in the organic soil. Depending on the harvest time, the average Sr 90 contents of the plants grown in the treated mineral soil were 59 to 69 percent less than that of the control plants. Clinoptilolite was effective in maintaining the reduced Sr 90 contents of the plants throughout the experimental period. The Cs 137 contents of the plants were not changed appreciably by the application of clinoptilolite. (Auth)

<894>

Nishita, H., R.M. Haug, and G.V. Alexander. Influence of Organic Matter on the Availability of Certain Elements to Barley Seedlings Grown by a Modified Neubauer Method. 1972. UCLA-12-888: 31 p. (University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

The influence of organic matter on the availability of 17 elements (Na, K, Cs 137, Mg, Ca, Sr, Ba, Mn, P, B, Cu, Zn, Fe, Mn, Mo, Al, and Si) to barley seedlings grown by a modified Neubauer technique was determined. Three different soils that were treated with dry ground mustard spinach leaves (1 g/100 g soil) and incubated for various lengths of time (0, 1, 2, 5, 9, 13, and 17 weeks) in moist condition before cropping were used for this study. The addition of organic matter to the soils increased the plant yields. The average N and K concentrations were consistently increased in the plants grown in soils with added organic matter. The average concentration of B, P, Na, Mg, Sr, Ba, and Si were almost consistently decreased in the plants. The average contents of Cu, Zn, Fe, Mn, Mo, Ca, and Al varied with the soil types and precropping incubation time. The average Cs 137 contents of the plants were reduced considerably by the addition of organic matter to the soils. The reduction of Cs 137 contents ranged from 29 to 75%, depending on the pre-cropping incubation time and soil type. The main factors causing this reduction were considered to be microbial immobilization, ion antagonism by K, carbohydrate dilution, and the state of decomposition and the kind of organic matter added to the soils. (Auth)

<895>

Nishita, H., R.M. Haug, and M. Hamilton. Influence of Minerals on Strontium 90 and Cesium 137 Uptake by Bean Plants. 1968. Soil Science, 105, 237-243 (University of California, School of Medicine, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

The influence of the addition of several minerals (clinoptilolite, "Verxite", bentonite, illite, kaolinite, vermiculite and bauxite) on the Sr 90 and Cs 137 uptake by bean plants grown in two contaminated soils was examined. The Cs 137 uptake by the plants was relatively small compared to Sr 90 uptake with all mineral treatments. Among the minerals studied, clinoptilolite had the greatest effect on both the Sr 90 and Cs 137 uptake. The Sr 90 uptake was significantly

reduced, while the Cs 137 uptake, although small, was increased. The effect of the other minerals ranged from no effect to small effects. Mineral treatment of soil either decreased the plant yield or had no effect. In no case was the plant yield increased. (Auth)

<896>

Nishita, H., and H.A. Hawthorne. Effect of Moisture Tension on the Concentration of Tracer Strontium 85 in Expressed Soil Solution. 1967. Soil Science, 103, 339-346 (University of California, Los Angeles, CA)

The concentration of tracer Sr 85 in soil solutions extracted with pressure membrane extractors was examined in relation to variable moisture content in different kinds of soils. The Sr 85 radioactivity in the soil solution was expressed as solubility factor, which was defined as the ratio of the amount of Sr 85 per ml of soil solution to the amount of Sr 85 per g of soil before extraction. For any given soil, the Sr 85 solubility factors increased as the soil-moisture tension increased. With soils of low moisture level, the solution extracting system did not attain the apparent equilibrium state by the end of the extraction period. For the majority of the soils studied, the critical moisture level for the attainment of apparent equilibrium state was between 0.1 bar and 1 bar. The Sr 85 solubility factors varied over a wide range among the different kinds of soils. For the 0.1-bar moisture range, the solubility factors for extracts at the apparent equilibrium state varied from about 0.009 to about 0.74. Various factors that appeared to affect the magnitudes of solubility factors are discussed. (Auth)

<897>

Nishita, H., B.W. Kowalewsky, and K.H. Larson. Influence of Soil Organic Matter on Mineral Uptake by Barley Seedlings. 1956. Soil Science, 82, 307-318 (University of California, Los Angeles, CA)

The influence of soil organic matter on uptake of Ca, Mg, K, Na, Mn, and tracer amounts of Sr 90-contaminating soils was studied by a modified Neubauer method using barley plants. As increasing quantities of organic matter were added to the soil, uptake of Sr 90, Ca, and Mg by plants decreased and uptake of Na and K increased. Large additions of organic matter to the soil reduced the uptake of Mn, but moderate additions increased its uptake. The mineral uptake by barley seedlings was influenced also by pre-cropping incubation time of the moist soil, the kind of organic matter, and the soil type. The soil microbial population showed a rapid initial increase and then a gradual decline with incubation time. The microbial population in the soil increased as organic matter concentration increased. Organic matter, directly or indirectly, appeared to have influenced mineral uptake by plants in several ways: microbial immobilization of ions, ionic antagonism, and "carbohydrate dilution" caused by increased plant yields. Although no direct evidence was obtained in these experiments, certain decomposition products of organic matter might also influence mineral uptake by plants. (Auth)

<898>

Nishita, H., B.W. Kowalewsky, and K.H. Larson. Influence of Soil Organic Matter on Mineral Uptake by Tomato Plants. 1956. Soil Science,

<898> CONT.

82, 401-407 (University of California, Los Angeles, CA)

The influence of soil organic matter on the uptake of Ca, Mg, Na, K, Hn, and Sr 90 contaminating Vina loam in tracer amounts was studied by pot experiments using the tomato as the test plant. The mineral uptake and plant yield were influenced by organic matter concentration, incubation time of the soil, and kind of organic matter. In general, the uptake of Sr 90 and Ca was highest with 1 or 2 g. additions of organic matter to 100 g. soil. The uptake of these two ions roughly paralleled each other. Magnesium uptake was highest at the 5 g. level of organic matter treatment. Uptake of Na and K increased as organic matter concentration in the soil increased. Uptake of Hn showed no consistent relationship with organic matter concentration or incubation time. A limited study of the plant availability of Sr 90 from nonradioactive soil treated with radioactive plant material and from radio-active soil treated with nonradioactive plant material showed but little, if any, difference between the two methods of contamination. Soil volume increases caused by the addition of organic matter to the soil had no appreciable effect on the uptake of Sr 90 per unit weight of plant material. (Auth)

<899>

Nishita, H., B.W. Kowalewsky, A.J. Steen, and K.H. Larson, Fixation and Extractability of Fission Products Contaminating Various Soils and Clays: I. Strontium 90, Ruthenium 106, Cesium 137, and Cerium 144. 1956. Soil Science, 81, 317-326 (University of California, Los Angeles, CA)

Water-soluble, exchangeable, and nonexchangeable forms of long-lived and medium-lived fission products (Sr 90, Y 91, Ru 106, Cs 137, and Cs 144) contaminating five soils and two clay minerals were studied by the use of leaching procedures. With few exceptions, the relative relationships of these fission products in the soils were: Water-soluble fraction: Ru 106 > Sr 90 > Y 91 > Ce 144 > Cs 137; Exchangeable fraction: Sr 90 > Cs 137 > greater than or equal to Ce 144 greater than or equal to Y 91; Nonexchangeable fraction: Ce 144, Y 91 > Ru 106 > Cs 137 > Sr 90. Exceptions were discussed on the basis of soil pH, chemical properties of radioisotopes, and clay mineral type. The relative relationships of the radioisotopes in the clay minerals were: Water-soluble fraction: bentonite: Ru 106 > Sr 90 > Cs 137 > Y 91, Ce 144 Kaolinite: Sr 90 > Ru 106, Cs 137 > Y 91 > Ce 144, Exchangeable fraction: Bentonite: Sr 90 > Cs 137 > Y 91, Ce 144 > Ru 106, Kaolinite: Y 91, Ce 144 > Sr 90 > Cs 137 > Ru 106, Nonexchangeable fraction: bentonite: Ru 106 > Ce 144, Y 91 > Cs 137 > Sr 90, kaolinite: Ru 106 > Cs 137 > Y 91, Ce 144 > Sr 90. In comparison with the other radioisotopes, Cs 137 and Ru 106 were fixed in relatively large amounts by kaolinite. Bentonite pretreated with dilute acid showed less adsorption of Cs 137 and Ce 144 than did untreated bentonite, which indicates that the hydrogen ion is more strongly adsorbed than are these ions. The pH of the leaching solution had great effect on the release of Y 91, Cs 137, and Ce 144. In the competitive adsorption between the soils and clay minerals and the Pyrex glass of the container, the radioisotopes showed a decidedly greater preference for the soils and clay minerals. (Auth)

<900>

Nishita, H., E.H. Romney, G.V. Alexander, and K.H. Larson, Influence of Potassium and Cesium on Release of Cesium 137 from Three Soils. 1960. Soil Science, 89, 169-176 (University of California, School of Medicine, Los Angeles, CA)

Experiments were conducted to study the influence of stable K and Cs amendments on the uptake of Cs 137 by Ladino clover upon prolonged cropping of contaminated soils. The addition of K to soils containing relatively high levels of K was ineffective in reducing Cs 137 uptake by plants, but after the soil K was reduced to a low level by cropping, the addition of K to soils reduced Cs 137 uptake by plants. This implies that K added to a soil may reduce Cs 137 uptake by plants when the soil is low in K content but not when high in K. The Cs 137 uptake by plants increased as the K concentration in the soil was reduced by cropping. The addition of small amounts of Cs to the soil markedly increased Cs 137 uptake by plants and reduced K uptake. The addition of Cs even at a level severely injurious to plants increased Cs 137 uptake rather than reduced it. The threshold level for producing injury to clover appeared to be around 4.5×10^{-4} me. Cs per g. soil in Vina loam. The toxic effect of Cs added in injurious amount to the soil was alleviated by the addition of K. K was, thus, antagonistic to Cs. The amount of Cs and K uptake by plants depended on the soil type. Uptake of Cs 137 by plants was in the order Hanford > Aiken > Vina, and, concurrently, K uptake was in the reverse order. (Auth)

<901>

Nishita, H., E.H. Romney, and K.H. Larson, Uptake of Radioactive Fission Products by Crop Plants. 1961, March-April. Agricultural and Food Chemistry, 9(2), 101-106 (University of California, School of Medicine, Laboratories of Nuclear Medicine and Radiation Biology, Department of Biophysics and Nuclear Medicine, Los Angeles, CA)

The uptake of several radioactive fission products from contaminated soils by crop plants through the root system, the distribution of the absorbed radioisotopes within plants, and some factors that modify the uptake and distribution of these radioisotopes in plants are discussed. The relative order of magnitude of uptake of fission products by plants appeared to be Sr 89-Sr 90 greater than I 131 greater than Ba 140 greater than Cs 137, Ru 106 greater than Ce 144, Y 91, Pu 147, Zr 95-Nb 95. There were considerable differences in uptake among different plant species and conditions of growth. Accumulation of each of the fission products studied was greatest in leaves of plants, but comparatively low in seeds, fruits, or edible roots. Fission product contents of plants may be altered by certain soil management practices such as cultivation, fertilization, and organic matter application. (Auth)

<902>

Nishita, H., A.J. Steen, and K.H. Larson, Release of Strontium 90 and Cesium 137 from Vina Loam upon Prolonged Cropping. 1958. Soil Science, 86, 195-201 (University of California, Los Angeles, CA)

Experiments were conducted to study the uptake of Sr 90, stable Sr, Ca, Cs 137, and K by ladino clover as a function of intensive and prolonged cropping of a contaminated soil

<902> CONT.

using the pot culture method. Uptake by plants was also studied in relation to exchangeable and nonexchangeable forms of these cations in the soil. The exchangeable Ca, stable Sr, and Sr 90 decreased with time of cropping, but the concentrations of these cations per unit weight of dry clover remained, in general, fairly constant among all harvests. The K uptake by clover decreased as the exchangeable K in the soil decreased. As the K uptake by the plants decreased the uptake of Cs 137 increased. Nonexchangeable K was shown to be available to plants, but the release of nonexchangeable Sr 90 and Cs 137 to plants could not be assessed by the method used. The fixation of Cs 137 in the soil appeared to have increased as nonexchangeable K was decreased by cropping. The maximum activity of Sr 90 and Cs 137 removed by a single crop of ladino clover were 4.42 and 0.13 percent of dose, respectively. Maximum cumulative total percentages of Sr 90 and Cs 137 removed by 9 crops obtained over the period of 516 days were 23.69 and 0.72, respectively. (Auth)

<903>

Nishita, H., P. Taylor, G.V. Alexander, and K.H. Larson, Influence of Stable Cesium and Potassium on the Reactions of Cesium 137 and Potassium 42 in Soils and Clay Minerals. 1962. Soil Science, 94, 187-197 (University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

Experiments were conducted to study the influence of stable Cs and K on the reactions of tracer quantities of Cs 137 and K 42 in soils and clay minerals, using an equilibrium batch method. Tracer quantities of both Cs 137 and K 42 were strongly sorbed in soils and clay minerals. Cesium was more strongly sorbed than K. Since the initial trace quantities of carrier-free Cs 137 were very strongly sorbed, the sequence of the addition of the tracer radioisotope in relation to the addition of stable Cs and K determined the level at which equilibrium was attained. The absolute amount of Cs and K sorption depended on the kind of clay mineral and soil. Cesium sorption relative to K was greater in Ca-clay than in H-Al-clay. The concentration of the stable Cs and K present was also an important factor. When the tracer Cs 137 was diluted to a negligible fraction of the total Cs in solution, only a negligible fraction of Cs 137 was sorbed. In equimolar mixtures of Cs and K, the sorption of Cs relative to K decreased as the ionic concentration increased. As a corollary to this effect, under conditions of low ionic concentration, stable Cs was much more effective than K in releasing Cs 137 from soils. In high concentrations, however, K may be, in certain soils, as effective as stable Cs. (Auth)

<904>

Noggle, J.C., C.T. De Wit, and A.L. Fleming, Interrelations of Calcium and Rubidium Absorption by Excised Roots of Barley and Plantain. 1964. Soil Science Society of American Proceedings, 28, 97-100 (U.S. Department of Agriculture, Soil and Water Conservation Research Division, Beltsville, MD)

The uptake rates of Rb and Ca, applied alone or together, by excised barley and plantain roots were compared. The barley roots absorbed Rb at a faster rate than Ca, whereas the reverse was true for plantain roots. The presence of Ca increased the rate of Rb uptake by barley roots, but the presence of Rb had

very little effect upon the Ca uptake. The uptake rate of either ion by plantain was reduced by the presence of the other ion. Calculations indicate that the depressing effect of one ion on the uptake of the other by plantain was due predominantly to ionic competition when the ions were present in the concentration range of 10-2M but factors in addition to competition were responsible in the concentration range of 10-4M. The significance of the differences in response of the two species is discussed. (Auth)

<905>

Nomik, H., A Technique for Determining Mineralization of Carbon in Soils During Incubation. 1971. Soil Science, 112, 131-136 (Royal College of Forestry, Department of Plant Ecology and Forest Soils, Stockholm, Sweden)

A simple, no-air-flow type of incubation technique is described for measuring amounts of CO₂ evolved from soil during incubation. The apparatus used is composed of one-litre incubation flask, a trapping device for CO₂ and a system for preventing moisture loss from the soil. The trapping unit is made up primarily of a polyurethane plastic foam plug loaded with a known amount of KOH standard solution. The alkali-treated plastic foam plug not only is an extremely effective absorbent for CO₂, but it also enables a relatively rapid gas exchange between the flask and outside atmosphere. The amount of CO₂ absorbed in the plug is determined titrimetrically. An arrangement consisting of plastic plugs in the terminal tube prevents moisture loss from the soil and contamination of the system with CO₂ from the laboratory atmosphere. In incubation tests reasonable good agreement was found to exist between this technique and the conventional method with a continuous-air-flow type of aeration. The technique is easily adapted to routine work, especially where long-term incubation is required. (Auth)

<906>

Nomik, H., A Modified Procedure for Determination of Organic Carbon in Soils by Wet Combustion. 1971. Soil Science, 111, 330-336 (Royal College of Forestry, Department of Plant Ecology and Forest Soils, Stockholm, Sweden)

A modified procedure for determining organic carbon in soils by wet combustion is described. The method is based on digestion of the sample with chromic-phosphoric acid solution at 160 degrees centigrade and collection of the CO₂ formed in a trapping unit attached to the digestion flask. The CO₂ is collected in a measured amount of KOH, the carbonate is precipitated with Ba (II) and the excess of KOH is titrated back with standard HCL. The sample amount weighted out for analysis is adjusted to contain at the maximum 120 mg.C. In calcareous soils the procedure can be extended to a simultaneous determination of carbonate carbon, in which case the analysis includes a pretreatment of the sample with metaphosphoric acid at 130 degrees centigrade. In comparison with the dry-combustion technique, the recovery of organic carbon in 47 soil samples by the proposed wet-combustion procedure amounted to 97.6 per cent on the average, the corresponding figure for mineral soil being 98.4 per cent and for organic soils 97.5 per cent. The coefficient of variance for the dry-combustion and wet-combustion techniques tested was 3.3 and 1.7 per cent, respectively. (Auth)

<907>

Not given, A Study of Natural Radioactivity in Brazil. 1968, August. NYO-2577-10; 48p. (Pontificia Universidade Catolica, Rio de Janeiro, Brazil)

Studies in two areas of high natural radioactivity in Brazil are reported. The areas include Guarapary, in the monazite sand region, and Morro do Ferro, in an area of volcanic intrusives. Thermoluminescent dosimeters were distributed to selected individuals residing in Guarapary and collected approximately six months later. Uncertainties in the dose rate measurements on the environment made by this method are discussed. Measurements of Rn and Th decay products in air and respirable dusts were not satisfactory. A whole-body counter was constructed. Plants collected from the Morro do Ferro area were analyzed for Ra 224 and Ra 226. Data on several species of Clethraceae and Melastomataceae are presented. (NSA)

<908>

Not given, Standardization of Radioactive Waste Categories. 1970. STI/DOC-10/101; Report of a Panel Held in Vienna, Austria, November 6-10, 1967, 20 p. (International Atomic Energy Agency, Vienna, Austria)

An IAEA panel report concerning the standardization of radioactive wastes is given. (CWF)

<909>

Not given, Strontium 90 Uptake by Desert Vegetation. 1972. TID-25954; Part of Radiocology and Ecophysiology of Desert Plants at the Nevada Test Site (p. 69-72)

The levels of Sr 90 uptake varied among different species of desert vegetation. A species of range grass, ORYZOPSIS HYMENOIDES, had the lowest Sr 90 content of the species investigated and, perhaps significantly, the lowest specific activity of Sr 90 per stable strontium of all the species. Highest uptake of Sr 90 occurred in ATRIPLEX CONFERTIFOLIA, ATRIPLEX HYMENELYTRA, and LYCIUM ANDERSONII. Nearly the same levels of Sr 90 concentrated in leaf and stem tissues of ARTEMISIA TRIDENTATA, ASTRAGALUS LENTIGINOSUS and LARREA DIVARICATA. In ATRIPLEX CONFERTIFOLIA and ATRIPLEX HYMENELYTRA the Sr 90 was concentrated highest in stem tissue. The other species studied concentrated as much as three times more Sr 90 in leaf tissues as in stems. A similar distribution pattern occurred for the stable strontium levels in leaf and stem tissues of these desert plant species. A higher correlation coefficient was obtained for Sr 90 x strontium than for Sr 90 x other cations or sum of cations. The leaf-stem ratio for the Sr 90 was more correlated with the leaf-stem ratio for stable strontium than with other cations. There was a positive correlation between specific activity of Sr 90 and the cation sum of leaves. (Auth)

<910>

Not given, Cycling of Stable Cesium in a Desert Ecosystem. 1972. TID-25954; Part of Radiocology and Ecophysiology of Desert Plants at the Nevada Test Site (p. 376-378)

Cesium was determined in plant, animal, and soil samples by neutron activation. Potassium was determined by counting K 40 by gamma spectroscopy. Samples were obtained from the Rock Valley area of the Nevada Test Site in 1969 and 1970. (NSA)

<911>

Not given, Exchange of Interlayer Cations in Micaceous Minerals, Summary Report, February 1, 1970-July 31, 1973. 1973. COO-1680-19; 27 p. (Iowa State University of Science and Technology, Ames, IA)

The diverse activities required by the broad scope of this project and the accomplishments of the past three years have been summarized in terms of seven lines of work. 1. A survey of the Cs content of micas led to a comparison of the distribution and exchangeability of indigenous Cs, Sb and K in the same sample. 2) Methods of adding interlayer Cs were evaluated and the exchangeability of added and indigenous Cs in various minerals was compared. 3) The effects of heat treatments on the exchangeability of K in coarse and fine-grained micaceous minerals were determined and related to properties of the mineral. A relationship between K exchangeability and muscovite dehydroxylation was established. 4) The rate of K exchange in micas was increased by adding H2O2 to the solution but no oxidation of Fe in the mica or exfoliation occurred. 5) The reaction temperature was shown to have an effect on the rate, degree and mode of interlayer K release. 6) The limited exchange of K in small mica particles was overcome by using low mineral/solution ratios. 7. New procedures were developed. (Auth)

<912>

Not given, Environmental Contamination. Part II. Transfer of Radioactive Material through Food Chains into the Human Body. 1962. Part of Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, Official Records: Seventeenth Session, Supplement No. 16 (A/5216), United Nations, New York, New York, 1962, (p. 287-346) (United Nations, Scientific Committee, New York, NY)

A comprehensive literature survey of transfer of radiocontaminates through food chains into the human body is presented. (CWF)

<913>

Not given, Strontium 90 in Soil. 1968. Bibliography No. 1034 (Commonwealth Bureau of Soils, Harpenden, England)

Seventy-five references are given, covering the period 1960 to 1966. (NSA)

<914>

Not given, USSR Reports on Natural and Fallout Radioactivity, Translation of Russian Articles. 1969. ABC-tr-7128; 286 p. (Academy of Sciences, Moscow, USSR)

Separate abstracts were prepared for the 24 papers appearing in this translation. Abstracts for the five papers appearing under report number A-AC-82/G/L-1243 were included in Vol. 23 of NSA as abstracts 24499, 24574, 24576, and 24604. These five abstracts, along with the lead abstract for the report (24573), were prepared from the papers in their original language. The same is true of the five papers appearing under report number A-AC-82/G/L-1254. The abstracts of these five papers (in their original language) also appeared in Vol. 23 of NSA as abstracts 24578, 24579, 24580, 24581 and 24711. The lead abstract for these papers was 24577. For abstracts of individual papers see: 11690, 11691, 11699-11701, 11709, 11901-11903,

<914> CONT.

12024-12033, and 12060-12064. (NSA)

<915>

Not given, Limiting Steps in Ion Uptake by Plants From Soil. 1966. STI/DOC-1065; IAEA Technical Report Series No. 65 (Not given)

Sixteen papers discuss various factors affecting ion uptake by plants from soil. The topics discussed include the kinetics of phosphate release from soil; thermodynamic and thermochemical measurements of ion exchange reactions in clays; the dielectric properties of montmorillonite at various water contents; the distribution of ions at surfaces; the roles of root interception, mass flow, and diffusion in regulating the uptake of ions by plants from soil; the role of mass movement and ionic diffusion in ionic migration through soils; the effects of soil physical processes on ion uptake; the diffusion of P and K through soil to plant roots; limitations to ion uptake by plants; the amounts of nutrients contacted by roots; primary processes of ion absorption by cells of higher plants; active and passive processes in ion translocation across root tissue; ion uptake under field conditions; oxidation-reduction status of the rhizosphere of rice roots in submerged soils; the uptake of ions by plants from salt-affected soils; and limiting steps in ion uptake by plants from soil. (NSA)

<916>

Not given, Movement of Strontium Through the Soil to the Plant Root Membrane, Technical Progress Report, June 1, 1971 - August 31, 1972. 1972. COO-1495-18; 41 p. (Purdue University, Lafayette, IN)

Progress is reported on investigations of the factors influencing the equilibrium distribution of Sr and Ca between the exchangeable, ionized in solution, and soluble chelate phases in the soil system and determinations of the principles involved in the supply of Sr to the plant root surface by mass-flow and diffusion from exchangeable, ionized solution, and soluble chelate forms in the soil. The distribution of Ca and Sr between the ionized phase in solution and the chelate ion complex was determined for two chelate compounds, EDTA and DPTA. The supply mechanism for movement of Ca and Sr to tomatoes and the action of chelates on the absorption of Ca and Sr by tomatoes from solution were investigated. (ST)

<917>

Not given, Movement of Strontium through the Soil to the Plant Root Membrane, Technical Progress Report, June 1, 1969 - May 31, 1970. 1970. COO-1495-12; 36 p. (Purdue University, Lafayette, IN)

Progress is reported on studies to determine the significance of root interception, mass-flow and diffusion in supplying Sr to the root membrane and to evaluate the significance of soil properties on the distribution and bonding of Sr in the soil. When wheat and soybeans were grown in nutrient solutions in which the Sr to Ca ratio was 1 to 600, soybeans absorbed these nutrients in the ratio that was present in the solution, but wheat preferentially absorbed Sr (Observed Ratio = 1.41). Other results indicated that contact exchange and exchange diffusion may be the principal mechanisms supplying Ca and Sr to the root when mass-flow supplies a minor fraction of uptake; more Ca than Sr was

translocated from the root to the shoot for both soybeans and wheat with Sr preferentially retained in the roots; there was differentiation in Sr and Ca translocation in both soybeans and wheat not due to rate of equilibrium within the plant; and the OR values for Sr and Ca ions present in the water free space of soybean and wheat roots were approximately one and greater than one, respectively, whereas the OR values for exchangeable root Sr and Ca were greater than one, indicating a preference for Sr. The relative rates of movement of Sr and Ca in soil columns were studied using column exchange chromatography. (ST)

<918>

Not given, Soil Chemistry. ORO-657; (p. 65-92) (University of Tennessee, Agricultural Research Laboratory, Oak Ridge, TN)

This research program is concerned with those properties of a clay system that control ion exchange kinetics and ion exchange equilibrium. This relates not only to the availability of cations to the plant, but also to those fission products in the soil in cation forms. It was found that the hydration status of the cation influences both the kinetics and equilibrium behavior of the clay-cation interaction, thus the predictions regarding the use of ion exchangers were based on the hydrated radii rather than on the crystal radii. Selection of the proper exchange medium will also influence the status of the radii of the cations depending on its weak or strong acid properties. Current research centers around the study of the selectivity sequence for the alkali metal cations on Kaolinite and Wyoming Bentonite clays at different pH levels. Progress is also reported in the area of diffusion kinetics in non-ideal systems. Analysis of the kinetics involved will result in a better understanding of the movement of fission products through complex soil systems. Also reported are data from research on specific reactions affecting cation availability in clay minerals. The specific reactions in this case are fixation reactions. Understanding of the kinetics of these reactions is important because two essential plant nutrients, K(I) and NH₄(+4), and the fission product, Cs(I), are among the cations most susceptible to fixation. Results to date indicate that once Cs(I) is sorbed on the surface of vermiculite it is effectively fixed and is thus not isotopically exchangeable with other Cs. What effects this will have on the exchangeability of Cs against other cations remains to be seen. (NSA)

<919>

Not given, Movement of Strontium through the Soil to Plant Root Membrane, Technical Progress Report, June 1, 1968 - May 31, 1969. 1968, June 31, - 1969, May 31. COO-1495-9; 37 p. (Purdue Research Foundation, Lafayette, IN)

Mechanisms involved in the uptake of Sr from soil by plant roots were studied. Results from experiments using several mineral soils and plant species showed more Sr and Ca were supplied to the plant root by mass flow than the plants could absorb. Data are presented on the content of Ca and Sr in soybeans (GLYCINE MAX) and wheat (TRITICUM AESTIVUM) grown in organic and mineral soils. The effects of soil properties on the distribution and bonding of Sr in soil were also studied using Sr 89 as a tracer. (NSA)

<920>

Not given. Behavior and Effects of Radionuclides in Soils and Plants. 1969-1970. UCB-34-P-23-15, 45 p. (University of California, Berkeley, CA)

Seedlings of beans and tomatoes were placed for four days in media containing Cs 137, Ru 106, or Sr 85. The plants were then transferred to normal culture solution and four weeks later the distribution of the isotopes was determined. Results were compared with those of earlier experiments on the forage plants, *Adenostoma* and *Ceanothus*. Retention of Sr 85 and Cs 137 by the root was much less pronounced in beans and tomatoes than in forage plants; however, retention of Ru 106 by the root was very pronounced in all plants. Within the shoot both Sr 85 and Cs 137 were more mobile in the forage plants than in beans or tomatoes. Experiments on the distribution and effects of Sr 85 on growth of dwarf peas showed that there were no effects on yield even at the highest concentrations. Both the root and shoot meristems remained uncontaminated and no deleterious effects on growth were observed. Roots of dwarf pea seedlings exposed to solutions of P 32 were observed, one week after treatment, to be thicker and shorter than normal and to have produced very few laterals. Standardization and readout procedures were developed for beta radiation dosimeters; this involved the construction of a 4-pi exposure chamber to provide known doses of radiation from Y 90 in solution. A preliminary dose-depth curve was obtained using polyethylene absorbers. Field experiments on Y 90 beta damage to corn, wheat, and lettuce crops showed that there was a severe reduction in the yield of lettuce and wheat, but no reduction in yield of corn was observed. (NSA)

<921>

Not given. Accumulation of Chromium 51 by the Beach Diatom, *CHAETOCERUS ARMATUS*. 1969. RLO-2047-5, App. G; 2 p. (University of Washington, Laboratory of Radiation Ecology, Seattle, WA)

To a culture of about 60 ml of *CHAETOCERUS ARMATUS* containing no, or very little, particulate matter, one uCi of Cr 51 was added. The culture was incubated at 18 degrees centigrade and samples taken at three, six, and twelve days. Results indicate that at least 90 percent of the Cr 51 is taken up in ionic form. (NSA)

<922>

Not given. Studies on Plant Absorption of Strontium 90 and Cesium 137 from Some Tropical and Subtropical Soils. 1963, July. FOA-4-4319; 38 p. (Royal Agricultural College, Department of Radiobiology, Uppsala, Sweden)

Plant absorption of Sr 90 and Cs 137 from six tropical and subtropical soils collected in South America was studied in pot experiments using winter rye as the test crop. The influence of additions of different anions and cations to the soils on plant uptake of the two fission products and of a number of plant nutrients was investigated. The results are discussed. (Auth)

<923>

Not given. Soil Chemistry. NYO-2043-216; (p. 48-73) (Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica)

The uses of tracer techniques to study various chemical properties and reactions of soils are

discussed. (NSA)

<924>

Not given. Burial of Leached Hulls at the West Valley Plant. 1969, September. DOCKET-50201-16; 32 p. (Nuclear Fuel Services, Inc., West Valley, NY)

The standard procedure for transfer of radioactive process waste to burial in a site licensed by the USAEC at the West Valley Processing Plant is described. The soil in this leached hull burial area features a thick (>55 ft) layer of silty till with 4 to 6 ft of granular, glacial till overburden. The transport system chosen was a carrier that can be loaded and unloaded remotely with access batches in the top. Photographs of the site and operation are included. (NSA)

<925>

Not given. Report on Radon and Helium Occurrences in Soil Gas. 1967, December. GJO-928-1; 58 p. (Colorado School of Mines Research Foundation, Inc. Golden, CO)

Studies were conducted to evaluate a method of exploring for subsurface uranium deposits by measuring the helium and radon content of soil gas. Soil and rock gas samples were collected for He and Rn analysis from shallow holes in areas of known He production in Arizona and New Mexico, and from a uranium producing district in Wyoming. The experimental procedures are described. It was found that the Ra content of soil and rock gas varied significantly in the Gas Hills, Wyoming, uranium producing area and may be of use in uranium exploration. However, the variations of He content and rock gas samples were not significant enough to be useful. Several recommendations are made for determining the effects of geologic conditions, sampling depth, and time on the measurement of He and Ra content in soil gas. (NSA)

<926>

Not given. Isotopes and Radiation in Soil Organic-Matter Studies. 1968, December. STI/PUB-190; CONF-680725; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Soil Organic-Matter Studies held in Vienna, Austria, July 15-19, 1968, 593 p. (International Atomic Energy Agency, Vienna, Austria)

Separate abstracts were prepared for five of the 48 papers presented in this symposium. The other 43 papers discuss the use of routine tracer techniques in relation to laboratory techniques for studying soil organic matter, properties of soil organic compounds, studies of nitrogen transformations in soils using N 15, organic-matter synthesis and decomposition in soil, organic matter in tropical soils, and organic-matter effects on nutrient availability in soils. Discussions are included, in English, at the end of each paper. (NSA)

<927>

Not given. Radiation from Natural Resources. 1966. Part of Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, Official Records: Twenty-first session, Supplement No. 14 (A/6314). United Nations, New York, (p. 13-43) (United Nations Scientific Committee, New York, NY)

Comprehensive literature survey on natural radioactivity in the environment is reported. (CWF)

<928>

Not given, Water Utilization and Calcium-Strontium Uptake in PHASEOLUS VULGARIS. 1964. Physiologia Plantarum, 17, 746-750 (University of Connecticut, Storrs, CT)

Polyethylene glycol 6000 was used to adjust the water flow through intact plants after which the translocation of strontium was measured. Data showed that discrimination occurred against strontium passage through the root. (CWF)

<929>

Not given, The Use of Isotopes in Soil Organic Matter Studies. 1966. Report of the FAO/IAEA Technical Meeting, Special Supplement to the Journal of Applied Radiation and Isotopes, Pergamon Press, New York, NY, 518p.

Report of FAO/IAEA meeting (1963) on use of radioisotopes in soil organic matter studies is given. (CWF)

<930>

Not given, Analysis of Radionuclide Transport Project-Progress Report. 1969. Progress Report: 25 p. (University of Texas, Austin, TX)

Prediction models for the transport of radionuclides into surface water have been investigated through the use of a model river system. This study was undertaken to evaluate the environmental factors affecting radionuclide transport through laboratory ecosystems and a model river. Measurements of the amounts of radioactive tracers retained in water, plants, and sediments in the research flume were reported. The results indicate that radioisotope transport in streams is influenced by the stream dispersion characteristics: the organic, inorganic, and thermal stream pollution; the amount of radioactivity already in the bed sediments; the amount of sediment agitation; and environmental factors such as plant growth, pH, light intensity, and oxygen content. Further experimental work for refining the mathematical models is recommended. (NSA)

<931>

Not given, The Behavior of Specific Nuclides in the Soil, Crops and Animals. EUR-1882; (p. 31-36) (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen, Netherlands)

Cesium penetration and retention was studied in bean leaves. Three hours after treatment approximately 80 percent of the isotope applied was washed out from primary leaves with 5 ml of water. Cesium concentration in tissues was found related to age and size of the leaf considered, immaterial of that treated. Leaf absorption tests were carried out to determine amounts of Cesium 134 adsorbed on the treated leaf of bean plants. Trends in adsorption of Cesium 134 by primary leaves following foliar application are presented. Results from radioautograms of leaf uptake experiments indicated a constant leaf-root distribution of P 32, Rb 86, and Cs 134. Regarding the soil soil-solution system, it was established that Sr and Ca, on the one hand, and K and Cs on the other, act more or less in the same way. Chlorine was a less suitable analogy for I. A theoretical study of the movement of Sr through soils was carried out, and an attempt was made to find semiempirical parameters to correlate theoretical assumptions with data obtained on four experimental farms in the Netherlands.

The effect of solutions of increasing osmotic pressure on Ca and Sr uptake by oat plants was measured, and no direct relation was found to exist between the uptake of both nuclides and the water uptake as measured by transpiration. A study was made of the influence of extra Ca on Strontium 90 excretion in cow's milk, and it appeared that an amount of 500 k Ca per hectare, given to grass, caused a decrease of Strontium 90 content in milk of about 33 percent. A study of the possibilities of decontaminating food while it is being treated or processed was initiated. Preliminary experiments were set up to see whether any selectivity in the distribution of cations in pressed juice of grass could be obtained upon addition of different chemical substances. Differences in K, Na, Ca, and Mg were not large enough to allow conclusions as to whether Ca and Sr could be extracted selectively. (NSA)

<932>

Not given, Soil Chemistry of Radioisotopes, Technical Summary, 1968-1969. UCB-34-P-23-X-1; 41 p. (University of California, Berkeley, CA)

The effects of soil pH on the uptake of Ru 106 by Ladino clover grown in the greenhouse on two different soil types were studied. The uptake and translocation of Cs 137, Ru 106, and Sr 89 by browse plants (Ceanothus and Adenostema) was studied following addition of the radioisotopes to culture solutions. The effects of internal beta radiation on the development of dwarf pea plants were studied following the addition of P 32 or Sr 89 to culture solutions. At the higher levels permanent damage was observed and fruit production was eliminated. Micro thermoluminescent dosimeters consisting of CaF2: Mn chips sealed in black polyethylene film were developed for use for beta dosimetry in soil. Field plots contaminated with Y 90 fused to quartz sand particles were prepared to assess beta radiation damage to field crops contaminated by fallout. Preliminary results are reported for lettuce and wheat. (NSA)

<933>

Not given, Movement of Strontium through the Soil to Plant Root Membranes, Technical Progress Report, June 1, 1967 - May 31, 1968. 1968. COO-1495-6; 47 p. (Purdue University, Lafayette, IN)

Progress is reported on studies to determine the significance of root interception, mass-flow and diffusion in supplying strontium to the root surface and to evaluate the influence of soil properties on the distribution of strontium and calcium between the solid and liquid phases of the soil as it relates to the supply to the root. Root interception plus mass-flow supplied more Sr and Ca to the plant root than was absorbed. There was a linear correlation between these two factors and plant uptake, but differences existed between species. There was a difference between the rates of Ca and Sr uptake of a 2-3 fold order of magnitude in favor of Ca uptake. Additional studies included determination of the variation of selectivity coefficients with soil properties, the effect of clay type on the bonding of Sr, the bonding of Sr and Ca by humic acid, and the influence of Sr saturation on the selectivity coefficient. (ST)

<934>

Not given, Movement of Strontium through the Soil to the Plant Root Membrane, Technical Progress

<934> CONT.

Report, June 1, 1970 - May 31, 1971. 1971.
COO-1495-15; 30 p. (Purdue University, Lafayette,
IN)

Progress is reported on studies to determine the significance of root interception, mass-flow and diffusion in supplying Sr to the root membrane and to evaluate the significance of soil properties on the bonding of Sr to various organic and inorganic fractions of the soil. Measurement of the exudate from decapitated soybean plants grown in a labeled solution of Sr and Ca showed that differential translocation of Sr and Ca occurred. The results confirmed the preferential localization of Sr within the roots. There was a difference between species in the Sr:Ca ratio of absorption from nutrient solution. Tomatoes and sorghum showed no differentiation between Sr and Ca in uptake. Soybeans had a slight preference for Sr. Lettuce and onions showed a preference for Ca. Uptake of Ca and Sr from exchange resin systems indicated the phase supplying the major portion of Ca and Sr to tomato plants. A third complementary cation, K, was used in a study of the differential variation in Sr and Ca binding within a soil. The selectivity coefficient, $k_{\text{sub Sr/Ca}}$ was used to interpret the differential bonding of cation exchange sites in two soils. As the equivalent fraction of Sr + Ca was reduced in the equilibrium solution, $k_{\text{sub Sr/Ca}}$ decreased. The free energy of exchange of Sr for Ca on a soil varied from 84 to -62 cal per mole as the equivalent fraction of Sr + Ca present in solution varied from 0.02 to 0.50. There was a linear relation between $k_{\text{sub Sr/Ca}}$ and log equivalent fraction Sr + Ca over a wide range of values. Sr diffused more slowly than Ca in a Sidell subsoil with a $k_{\text{sub Sr/Ca}}$ of 1.2. The Sr:Ca ratio of diffusion by both exchange and solution diffusion tended to exceed diffuse solely by solution diffusion in Sidell subsoil with a $k_{\text{sub Sr/Ca}}$ of 1.2. This is in the direction that indicates some contribution of exchange diffusion. (Auth) (ST)

<935>

Not given. Movement of Strontium through the Soil to Plant Root Membranes, Technical Progress Report, June 1, 1966 - May 31, 1967. 1967.
COO-1495-2; 20 p. (Purdue University, Lafayette,
IN)

Plant growth experiments using four soils and four crops were conducted to evaluate the role of root interception, mass-flow and diffusion in supplying strontium and calcium to the plant root. Results, given in graph form, showed species differences in Ca and Sr uptake and either a preferential absorption of Ca relative to Sr or that more Ca than Sr reached the root than was calculated. The effect of soil properties on the distribution coefficient of Ca and Sr between the solid and liquid phase of the soil was also investigated. Selectivity coefficients were correlated with soil properties and the amount of fixed Sr in the soils was evaluated. (ST)

<936>

Novikova, S.K., and E.B. Tyuryukanova,
Distribution of Strontium 90 in the Meadow-Steppe Zone Soils. 1968, December. Pochvovedenie, 12,
46-52 (Vernadskiy Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

A higher content and a more uniform distribution of Sr 90 were observed in the chernozem soils of the meadow-steppe zone as compared with the south taiga zone. A maximum

radioactive strontium content was found in upper horizons of chernozem soils and in calcareous horizons of calcareous chernozems. Strontium 90 penetrates as deep as 100 cm. A seasonal migration of Sr 90 is observed in the profile of chernozems. (Auth)

<937>

Nye, P.H., The Measurement and Mechanism of Ion Diffusion in Soil. I. The Relation Between Self-Diffusion and Bulk Diffusion. 1966. Sci. Avenir, 255, 408-415 (University of Oxford, Soil Science Laboratory, Oxford, England)

If an exchangeable ion in soil diffuses along a liquid and solid pathway, its diffusion coefficient may be expressed as $D = D(\text{sub } l) v(\text{sub } l) f(\text{sub } l) \times dC(\text{sub } l)/dC + D(\text{sub } s) v(\text{sub } s) f(\text{sub } s) \times dC(\text{sub } s)/dC$ where D , v , f , C are diffusion coefficient, volume fraction, impedance factor, and concentration terms and the suffixes l , s refer to liquid and solid. The self-diffusion coefficient of the ion is then $D' = D'(\text{sub } l) v(\text{sub } l) f(\text{sub } l) \times C(\text{sub } l)/C + D'(\text{sub } s) v(\text{sub } s) f(\text{sub } s) \times C(\text{sub } s)/C$ where D' , $D'(\text{sub } l)$, and $D'(\text{sub } s)$ are self-diffusion coefficients. D and D' will vary with concentration. In diffusion out of the soil to a zero sink, the appropriate average diffusion coefficient is, approximately, the self-diffusion coefficient in the undisturbed soil. Diffusion of one ion species is influenced by other ions diffusing in the system through the diffusion potential set up. When ions are diffusing to plant roots, the diffusion potential is likely to be small. A more likely, though more complicated, expression for D than the first equation above is derived by assuming the ion to follow solid and liquid pathways in series as well as in parallel. (Auth)

<938>

Odum, H.T., The Stability of the World Strontium Cycle. 1951. Science, 114, 407-411 (University of Florida, Department of Biology, Gainesville, FL)

Stable strontium analysis of fossils over geologic time indicate that the world strontium cycle is stable. (CWF)

<939>

Ohnomo, Y., and M. Saiki, Deposition of Iodine 131 on Plant Leaves. I. 1971, January. Radioisotopes, 20, 15-19 (National Institute of Radiological Sciences, Tokai, Japan)

The deposition and the distribution of organic and inorganic I 131 on spinach, Chinese cabbage, Komatsuna, and camellia leaves was determined using quantitative analysis and autoradiography. The deposition of CH3 I 131 on Chinese cabbage, spinach, Komatsuna, and camellia leaves was similar. The average concentration of I 131 sub 2 was greater on spinach and Chinese cabbage than for camellia leaves. It was suggested that I 131 sub 2 concentrated on leafy vegetables to a greater extent than did CH3 I 131. Removal of I 131 from the contaminated leaves was attempted by washing them with detergent, CCl4, ether, 0.5N HCl, and 0.5N NaOH with very little success. (NSA)

<940>

Olafson, J.H., H. Mishita, and K.H. Larson, The Distribution of Plutonium in the Soils of Central and Northeastern New Mexico as a Result of the Atomic Bomb Test of July 16, 1945. 1957. UCLA-406; (p. 1-18) (University of California,

<940> CONT.

School of Medicine, Los Angeles, CA)

Soils and plants from the area of central and northeastern New Mexico, which was contaminated by fallout from the atomic bomb detonation of July 16, 1945, were analyzed for plutonium. Plutonium was found in amounts up to 0.07 micrograms per square foot of soil, one-half inch deep, at a distance of 88 miles northeast of the site of detonation. A maximum of 1.47 micrograms per square foot, one-half inch deep, was found on the Ghupadera Mesa at a distance of 28 miles northeast of the detonation site. No plutonium was found in samples collected 3 miles south of the site. In assaying for plutonium, the method of Eisenacher was adapted to soil and plant samples. An estimated precision of plus or minus 15 percent was obtained when the method was applied to field samples. A recovery of 98.0 plus or minus 3.0 percent was obtained when the method was applied to a "standard" soil. Uranium and thorium do not interfere in this method even when they are present in quantities much greater than the maximum amounts normally found in soils. (Auth)

<941>

Oliver, S., and S.A. Barber, Mechanisms for the Movement of Manganese, Iron, Boron, Copper, Zinc, Aluminum, and Strontium from One Soil to the Surface of Soybean Roots (GLYCINE MAX). 1966, July-August. Soil Science Society of America Proceedings, 30, 468-470 (Purdue University, Lafayette, IN)

The role of root interception, mass-flow, and diffusion in supplying ions to soybeans growing in a leached subsoil was investigated. Root interception was the main mechanism for the supply of Cu, Al, and Sr to the soybean roots. Massflow was the most important for B and diffusion was the most important for Mn, Fe, and Zn. The data represent results on one soil, a leached Sidell silt loam subsoil. The levels of Mn, Fe, B, Cu, Zn, Al, and Sr in it were such as to make it useful for this study on the mechanism of movement of these ions. The significance of the mechanisms for the supply of each ion is affected by plant grown, climatic conditions, soil. The mechanisms reported as being the most significant for each ion in this study are in many instances likely to be the same ones that are most significant under conditions where these ions are present at relatively low levels in the soil. The data illustrate how the amounts moved by each mechanism can be calculated to indicate their relative importance for determining the availability of the nutrients to plants growing in soil. (NSA)

<942>

Oliver, S., and S.A. Barber, An Evaluation of The Mechanisms Governing the Supply of Calcium, Manganese, Potassium, and Sodium to Soybean Roots (GLYCINE MAX). 1966. Soil Science Society of America Proceedings, 30, 82-86 (Purdue University, Agriculture Experiment Station, Department of Agronomy, Lafayette, IN)

Three mechanisms, root interception, mass-flow, and diffusion, govern the rate of supply of nutrients from the soil mass to the plant root. Two experiments were conducted to evaluate methods developed for calculating the supply of ions to the roots by mass-flow and by root interception. Root interception values were calculated by assuming that all the exchangeable and soluble ions were in the pore space and that the roots intercepted an amount in proportion to their volume.

Mass-flow was calculated by multiplying the amount of water uptake of the plant by the concentration of ions in this water as determined from analysis of a saturation extract. Contributions of mass-flow were varied by creating three rates of transpiration. The results indicated that mass-flow was significant for supplying Ca and Mg but was of little importance for Na and K in the soil used. Increases in mass-flow of Ca and Mg were highly correlated with increases in the uptake of Ca and Mg by the plant. In a second experiment, root interception of Ca and Mg was varied by using soil-sand mixtures varying from 100 percent soil to 20 percent soil and 80 percent sand. Mass-flow was minimized by leaching the soil before use. The results indicated that the calculated Ca uptake by root interception gave a reasonably close approximation to uptake of Ca minus mass-flow Ca. (Auth)

<943>

Oreshko, V.F., A.I. Berdnikov, and V.V. Przhbyl'skii, Sorption of Radioactive Cobalt by Peats. 1962. Soviet Radiochemistry, 4, 437-440 (Not given)

The kinetics of adsorption of radioactive cobalt from solutions of low activity by peats of various types with different degrees of decomposition were studied. It was established that hypnum and sedge-hypnum peats have the highest adsorption rate. The adsorption rate and maximum adsorption of these peats in the case of solutions of low activity depend little on the degree of pulverization. Both types of peat could be used for the purification of radioactive waste waters by filtration, as both have good filtration properties. It was established that the adsorption rate falls with an increase in the degree of decomposition, while the maximum adsorption is least in the case of peats with an average degree of decomposition (20-40%). Peats with low and high degrees of decomposition have a high adsorption capacity for solutions of low activity. (Auth)

<944>

Osburn, W.S., Primordial Radionuclides: Their Distribution, Movement, and Possible Effect Within Terrestrial Ecosystems. 1965. Health Physics, 11, 1275-1295 (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO)

The paper briefly summarizes the world-wide distribution of naturally occurring radioactive materials and provides a more detailed account of their occurrence and movement within specific ecosystems. General pathways of nuclide distribution and sites of concentration are pictured by tracing radioactive substances from the long-lived primary material to the inactive end product. This tracing includes major environmental and biological transport mechanisms to which radionuclides are subjected during the course of their life span. Thus, the biology of these naturally occurring nuclides is reviewed. The ecological life history of various plants and animals are outlined and the radiosensitivity of the various stages are considered. Where stages of high radiosensitivity are coincidental with exposure to relatively high levels of background radiation, possible biological effects are discussed. Special attention is given to the interaction of ionizing radiation with other environmental stresses. (auth)

<945>

Osburn, W.S., Ecological Concentration of Nuclear Fallout in a Colorado Mountain Watershed. 1967. CONF-660405; Part of Aberq, B. and Hunkate, F.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England,). 675-709), 1051 p. (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO)

A detailed survey of the radionuclide content of numerous ecological specimens in a Colorado mountain watershed is presented. Food chain studies showed a drastic reduction in total beta radioactivity at each food chain step with the exception of movement to the larva stage. (CWF)

<946>

Ovchenkov, V.Ya., Radium Migration From Sites of its Concentration under Natural Conditions. 1972. Part of Verkhovskaya, I.N. (Ed.), Radioekologicheskie Issledovaniya v Prirodnikh Biogeotsenozakh, Izdatel'stvo Nauka, Moscow, USSR (Not given)

The results of laboratory experiments corroborate the statement that, other conditions being equal, the passage of radium from natural substrates into the liquid fraction is determined by the nature of the substrate and the form in which the radioelement occurs in it. Radioactive rocks, clays, and soils contain but small amounts of mobile forms of radium. The desorption of radium from these substrates is quite insignificant. In sand and in sand with various admixtures, radium is less solidly bound and may, under certain conditions, pass practically entirely into the liquid phase. (Auth)

<947>

Ovchenkov, V.Ya., and D.M. Rubtsov, Content of Radioactive Isotopes of the Uranium and Thorium Series in Soils. 1972. Part of Verkhovskaya, I.N. (Ed.), Radioekologicheskie Issledovaniya v Prirodnikh Biogeotsenozakh, Izdatel'stvo Nauka, Moscow, USSR (Not given)

Investigations of the radioisotope composition of soils in regions with a high natural radiation background showed that the soils of sites with a high radiation level differ sharply from control sites in regard to their content of radioisotopes of the uranium and thorium series. A feature common to all the soils investigated is the presence of thorium in concentrations exceeding by 1.5 to 3.5 times the mean thorium content in the soils of the Russian plain. On the basis of this character, the region investigated may be recognized as a geochemical province. A high content of radioactive isotopes (with the exception of thorium) is found mainly in the 0 to 25 cm layer. The soils of radium sites contain high (as compared with the state of radioactive equilibrium with Th) amounts of ^{228}Ra , ^{228}Th . Uranium-radium sites have a high uranium, radium, and thorium content in the upper horizons. At a depth of 25 to 125 cm (radium sites), a radioactive equilibrium is observed in the thorium series up to ^{228}Ra . The lower radiation level in radium sites is accounted for not only by the migration of isotopes but also by the decrease of ^{228}Ra and ^{228}Th in the process of radioactive decay. (Auth)

<948>

Overbeek, J.T.G., Donnan-Electromotive Force and

Suspension Effect. 1953. Journal of Colloid Science, 8, 593-605 (Massachusetts Institute of Technology, Department of Metallurgy, Cambridge, MA)

The Donnan-emf may be defined as the emf of the cell obtained by connecting two identical electrodes by means of saturated KCl bridges to a suspension and its equilibrium liquid. The suspension effect is the difference in emf obtained in the conventional determination of the pH in a suspension and in its equilibrium solution. It is shown that the Donnan-emf and the suspension effect are identical. The Donnan-emf can be calculated from the chemical potentials and the transference numbers in the two liquid junctions. It is pointed out that the measured potential can not be separated into a "true" Donnan-or membrane-potential and two liquid junction potentials without arbitrariness. Explicit equations for the Donnan-emf are given for a number of typical cases. It appears that the classical equation for the Donnan-potential is in error if the mobilities of the reagents are modified by the presence of the particles, which presumably is the case, unless the particle charge is extremely small. (Auth)

<949>

Ozanne, P.G., and C.H.E. Werkhoven, Calcium Uptake by Subterranean Clover Bur Shown by Using Calcium 45. 1971. At. Energ. (Aust.), 14, 16-18 (Commonwealth Scientific and Industrial Organization, Western Australia Laboratories, Membley, Western Australia; Institute for Soil Fertility, Baren, Groningen, Netherlands)

The movement of Ca 45 as CaCl_2 through the seeds of subterranean clover, was examined. Florets of the plant in flower were wrapped in wads of cotton wool and slipped into plastic vials. The cotton wool was moistened with a solution containing 240 ppm Ca labelled with 1 $\mu\text{Ci}/\text{ml}$ of Ca^{45} . Plastic caps through which the peduncle passed were placed on the vials. After 2 months Ca^{45} distribution was determined by sampling ashed sections of clover runners. Results showed that the bur developing in contact with a Ca solution of a concentration within the range of those found in soils, absorbs sufficient Ca for healthy seed formation. (NSA)

<950>

Paasikallio, A., U. Hakkinen, and E. Lakanen, The Effects of Soil Factors on the Uptake of Radiostrontium by Plants. Part III. Ann. Agr. Fenn., Ser. Agrogeol., Chim. Phys., 10, 125-130 (Agricultural Research Center, Tikkurila, Finland)

The proportional uptake of Sr 89 in relation to Ca by plants growing in different types of peat soils was found to decrease with increasing degree of decomposition, i.e. with decreasing C/N ratio, and with increasing humic acid content and CEC (meq/l) of the growth medium. Increasing amounts of various fractions of organic matter (humic, and humic acids) mixed with a finesand decreased the uptake of radiostrontium and calcium by plants. However, the Sr 89/Ca ration of the plants increased when the organic matter content of the soil was low. (Auth)

<951>

Pablo, B.B., Radiotracer Adsorption Study on Baquio Soils. 1970. Philippine Nuclear Journal, 2(2), 211-214 (Philippine Atomic Energy Commission, Manila, Philippines)

<951> CONT.

Cationic tracers used in seepage tracing have been found to suffer great losses from adsorption. This investigation of the adsorptive properties of different soils near Baquio City was carried out to find a most suitable radiotracer. Chelation of these cations or conversion to complexes and addition of carrier improved the performance of these tracers. Sodium iodide (I 131) and potassium cobalticyanide (Co 60) were found to be the least adsorbed. (Auth)

<952>

Palumbo, R.P., The Difference in Uptake of Radioisotopes by Marine and Terrestrial Organisms. 1961. Part of Recent Advances in Botany, University of Toronto Press, Toronto, Canada, 1961, (p. 1367-72) (University of WA, Seattle, Washington)

The elements in radioactive fallout that form strong complexes with organic matter, such as the transition elements and some of the anions, and those that are present in the particulate or colloidal form are present in highest amounts in the marine organisms. These radioisotopes include the non-fission products Co 57, 58, 60, Fe 55, 59, Zn 65, and Mn 54 and the fission products Zr 95, Nb 95, Ru 106, and Ce 144 and Pr 144. On the other hand, the fallout materials that are soluble are the ones taken up in highest amounts by the land plants and animals. These include Sr 90 and Cs 137. (Auth)

<953>

Parfenov, Yu.D., Is There Any Polonium Hazard. 1966. November. Med. Radiol., 11(11), 69-75

Studies on the dangers of natural Po 210 to humans are briefly reviewed. Results emphasized the hazards to man of inhaling the Po 210 in tobacco smoke. Data on the Po 210 radiation dose to the bronchial epithelium of persons who smoke cigarettes are presented. (NSA)

<954>

Paulus, K.O., Material Transport in Plant Foods with Regard to Radioactive Contamination and Decontamination. 1970, July. NF-18641 (Karlsruhe University, Karlsruhe, German Federal Republic)

Using mainly potato tissue, the uptake of Cs 137, Sr 90, Zr 95, and Ce 144, was studied theoretically and experimentally. Radioisotope transport through living tissue could not be explained by diffusion alone; two other processes played an important role: incorporation of radioisotopes into the intercellular space because of osmotic pressure differences, and binding of radioisotopes in the tissue because of biochemical reactions. Through introduction of correction factors for the two processes, a satisfactory differential equation could be derived. With respect to decontamination, thermal treatment with organic acids, especially citric acid, was successful. Equally satisfactory was a short treatment with hot water followed by washing in cold water. It was concluded that the procedures might possess general applicability to the decontamination of plant tissue. (Auth)

<955>

Paulus, K.O., Amount and Distribution of Radionuclides in the Potato Plant. 1966. Z. Lebensm.-Untersuch. Forsch., 131, 80-89

(Bundesforschungsanstalt fuer Lebensmitteluntersuchung, Karlsruhe, German Federal Republic)

The radioactive contamination of potatoes and other foods from fallout in Germany during 1964 is reported. Methods of radiochemical analysis of the potato plants for Strontium 90 and Cesium 137 are described. The ratio of Cs 137 to Strontium 90 in the plant foliage was 6.9 and in the potato the ratio was 15. Analysis of the plant material showed the presence of 36, 250, 500, 600, <100, and <100 pCi/Kg of Sr 90, Cs 137, Ce 144, Ru 106, Mn 54, and Eu 155, respectively. The potatoes contained only Sr 90 and Cs 137. The amounts decreased sharply from the outside to the inner portions of the potatoes. Only 15 percent as much Cs 137 activity was found in the peel as in the plant materials, and the Sr 90 activity in peel was only 7 percent of that in the plant. Over 60 percent of the Sr 90 activity in the potato was located in the peel, while the remainder was found within the potato substance. The Sr 90 activity was distributed like the concentration of Ca, while the Cs 137 distribution resembled the K distribution. (NSA)

<956>

Pavlotskaya, F.I., Correlations Between Rates of Entry of Strontium 90 from the Atmosphere, Its Content in Soil Cover and Quantity of Precipitation. 1969. A-AC-82/G/L-1300; AEC-tr-7128; Part of USSR Reports on Natural and Fallout Radioactivity, (p. 214-234) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

Using strontium 90 fallout data from the USA, Great Britain and the USSR, coefficients of correlation and linear equations were used to correlate the quantity of rainfall and rate of strontium 90 deposited to its content in soil. It was pointed out that dry fallout plays an important contribution in the total content of strontium 90 in the soil. Furthermore, a large part of the strontium 90 fallout may be leached through the surface soil depending on intensity of fallout, precipitation, and physicochemical properties of the soil. (CWF)

<957>

Pavlotskaya, F.I., G.N. Aranautov, and M.I. Blokhina, Possible Strontium 90 Bonds With Different Fractions of Organic Matter From Meadow-Chernozem Soil. 1972. Soviet Soil Science, 1, 83-89 (Main Hydrometeorological Service Administration, USSR)

The results are reported of a study of Sr 90 distribution between various groups and fractions of organic matter from a Meadow-Chernozem soil sampled from an experimental area 10 years after a surface application of this radioisotope. The content of Ca, Fe, Al, and of organic carbon was determined at the same time. It was found that Sr 90 was contained in the soil in the form of complex compounds including the aforementioned elements. (Auth)

<958>

Pavlotskaya, F.I., and G.A. Fedoseev, Using Total Beta-Activity Data for the Assessment of Radioactive Element Content in Soils and Plants. 1967. Pochvovedenie, 10, 119-124

Data are presented on individual radioisotope contributions to the total beta-activity of different plants. Because of the absence of

<958> CONT.

correlation between the total value of beta-activity and the deposit into it of beta-radiation of K 40 and some artificial radioisotopes, the former may be used for approximate assessments of individual radioisotopes. (Auth)

<959>

Pavlotskaya, F.I., G.A. Fedoseev, E.V. Babicheva, L.N. Zatssepina, and E.B. Tyuryukanova, Method of Determining Strontium 90, Stable Strontium, and Calcium in Soils and Plant Residues. 1964. Soviet Soil Science, 2, 197-204 (Vernadskiy Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

This is a review of the literature concerning methods of strontium 90 analyses in soils and plants. (CWF)

<960>

Pavlotskaya, F.I., E.B. Tyuryukanova, and V.I. Baranov, On the Mobility of Strontium and Some Other Components of Global Fallout in Soils and Their Accumulation in Plants. 1967. CONF-660405: Part of Aberq, B. and Hunsate, P.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, (p. 25-32), 1051p. (Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

The relative mobility of several fission products, Sr 90, Ce 144, Cs 137, in a number of soil profiles were evaluated. In order of decreasing mobility Sr 90, Ce 144, Cs 137 were normally found to move through soil profiles. (CWF)

<961>

Pavlotskaya, F.I., and E.B. Tyuryukanova, The Influence of Natural Conditions on the Content and Distribution of Radioactive Strontium in the Soil Cover. 1967. A-AC-82/G/L-1175: 16p. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

The content of radioactive strontium in the soil cover, apart from the level of its influx from the atmosphere, depends on the type of soil the form of vegetation, the hydrometeorological conditions, the geomorphological composition of the area, and other natural factors. The latter explains to a significant degree the irregular character of the distribution in the landscape. The rate of the accumulation of Sr 90 in the soil cover at different depths (up to 20 cm) during 1960 to 1963 was on an average 20 to 30 percent lower than its accumulation rate on the earth's surface, which indicates its erosion from the surface level. (tr-Auth) (CWF)

<962>

Pavlotskaya, F.I., E.B. Tyuryukanova, and V.I. Baranov, Global Distribution of Radioactive Strontium over the Earth Surface. 1970. Izdatel'stvo Nauka, Moscow, USSR, 160 p.

The book consists of three chapters. The first chapter covers the variations in Sr fallout in the atmosphere. The second chapter deals with the laws of strontium distribution over the earth's surface. The third chapter covers the peculiarities of strontium concentration in certain soils and landscapes of various soil-climatic regions in the Soviet Union. Extensive references are included. (NSA)

<963>

Pavlotskaya, F.I., E.B. Tyuryukanova, L.N. Zatssepina, E.V. Baticheva, and V.I. Baranov, Strontium 90, Stable Strontium and Calcium in the Soil and Vegetable Food Products. 1965. Gig. Sanit., 11, 54-63

The distribution and content of Sr 90 in the arable stratum of turf-podzolic grey-forest and chernozem soil depend on the strontium mobility and the agricultural technique used. A higher content of this isotope was noted at the depth of 10-20 cm. Stable strontium and calcium are more evenly distributed in the arable stratum of these soils. No relation could be traced between the Sr 90 content of the soil and that of the plants, as it depends on a great number of factors: first of all there may be direct contamination of the parts of plants above the soil; in 1961, for example, the portion of plants contaminated above the soil comprised on the average 36 percent, the portion of isotope entering the plant through the root system amounted to 64 percent. The amount of Sr 90 removed by the plants did not exceed 3 percent of its content in the soil. (Auth)

<964>

Pavlotskaya, F.I., L.N. Zatssepina, E.B. Tyuryukanova, and V.I. Baranov, The Mobilities and Forms of Strontium 90, Stable Strontium, and Calcium in Turf-Podzolic and Black Earth Soil. NP-16261: 21 p. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

While numerous experimental investigations established the ion exchange effects during Sr 90 migration in soil, the migration of this isotope under natural conditions in different types of soil is not sufficiently understood. Consequently, in August of 1961 and 1963 the authors carried out comprehensive studies of strontium 90, stable strontium, and calcium mobilities. In arable turf-podzolic soil, the mobilities of these three isotopes are almost identical and are of the order of 90 percent; in typical black earth soil the radioactive and stable strontium mobilities are about 65 percent, while that of calcium is 85 percent. The mobility is defined here as the ratio of the total content in the water soluble and exchangeable states, to the content of acid-soluble states expressed in percent. Differences found in the mobilities of the two types of soils and between the mobilities in cultivated and virgin land are determined basically by the amounts of these isotopes found in water-soluble form. Under otherwise equal conditions, more Sr 90 is water-soluble than the other two isotopes. In addition to the physical and chemical properties of the soil, the forms in which Sr 90, stable strontium, and calcium appear and their distributions and mobilities are affected significantly by the form in which they appear, the peculiarities of the composition of virgin soil, and the agricultural techniques employed. (NSA)

<965>

Pearson, J.E., Natural Environmental Radioactivity from Radon 222. 1967. PHS-999-RH-26; 31 p. (National Center for Radiological Health, Rockville, MD)

Radium 226 and Radon 222 were measured using a de-emanation method in which the gaseous daughter, Radon 222, is collected and analyzed by an alpha-scintillation method. "Emanating Radium 226" from particles of soil in clay

<965> CONT.

type soils varied from $0.342 \times 10(E-12)$ grams per gram of dry soil to $0.690 \times 10(E-12)$ grams per gram. Sandy soils varied between $0.147 \times 10(E-12)$. Highest activity measured was $14.3 \times 10(E-12)$ grams of "emanating Radium 226" per gram of dry soil containing uranium ore. Emanation from ground in Champaign County, Ill., for 216 measurements, was $(140 \text{ plus or minus } 73) \times 10(E-18)$ curies of Rn 222/cm²sec. Other soils released similar values of Rn 222 except at locations where U 238 is available in commercially significant amounts. Release of Rn 222 from the leaves of corn about midday and near the growth peak was approximately 2.6 times that of the soil under the corn at Argonne National Laboratory in one series of six tests. Radon 222 concentrations in the atmosphere were measured in eight series of 24-hour tests, at elevations of 16 m. Values of concentration at various times of the day are presented for the normal environmental levels. (Auth)

<966>

Pendleton, R.C., and R.D. Lloyd, Zirconium 95 in Utah Vegetation Produced during the 1966 Growing Season. 1970. Radiological Health Data and Reports, 11, 277-281 (University of Utah, Salt Lake City, UT)

Levels of Zr 95 in crops and dust from farm implements indicated widespread contamination of Utah with fresh fission products during May or June 1966. Although the exact origin and date of arrival of the Zr 95 in these vegetation samples cannot be determined from available evidence, at least part was probably from the May 9, 1966 atmospheric nuclear detonation on the Chinese mainland. No important increase of iodine 131, cesium 137, or strontium 90 has been reported for these months, but there is evidence that farm workers could have been exposed to secondary aerosols containing relatively high levels of radioactivity. This indicates that a potential radiological hazard may have occurred in the past and that highly contaminating incidents may recur, if a highly contaminating incident takes place in the future. (Auth)

<967>

Pendleton, R.C., and R.L. Uhler, Accumulation of Cesium 137 by Plants Grown in Simulated Pond, Wet Meadow and Irrigated Field Environments. 1960. Nature, 185, 707-708 (Hanford Laboratories, Biology Operation, Richland, WA)

Data is presented which shows cesium 137 uptake is much greater under flooded soil conditions than at field moisture capacity. The authors suggest cesium 137 uptake from wet-lands may explain the deviations from a correlation between rainfall and milk content and the abnormally high cesium 137 content in flooded rice. (CWP)

<968>

Penna-Franca, E., Radiochemical and Radioecological Studies on Brazilian Areas of High Natural Radiation. 1968, July. NYO-3273-11 (Brazil University, Instituto de Biofisica, Rio de Janeiro, Brazil)

Studies in three areas of high natural radioactivity in Brazil are presented. The areas include Guarapary-Maiepe, in the monazite sand region, and Araxa and Morro do Ferro, both in areas of volcanic intrusives. Estimations were made of the annual uptake of heavy radionuclides, particularly Ra 226 and

Ra 228, from food by members of selected families. A number of foods grown locally were analyzed for Ra 226, Ra 228, and Ca contents. Attempts were made to estimate the body burdens of heavy radionuclides in inhabitants based on results of radiochemical analysis of human bones, teeth, and placental tissues for Ra 226 and Th 228. Chromosome aberrations in cultured lymphocytes from peripheral blood were analyzed as a measure of possible biological effects of chronic radiation exposure. The effect of high levels of natural radioactivity on the evolutionary process of native vegetation was also studied and selected plant species were examined for plants with large chromosomes and sterile pollen. A comparison was made of the genetic load and radioresistance of natural populations of EROSOPHILA inhabiting radioactive and normal environments. Plants, mostly Angiosperms, and insects, including grasshoppers, termites, and tiger-beetles, were collected for studies on anatomy, morphology, and genetics. (NSA)

<969>

Penna-Franca, E., Radiochemical and Radioecological Studies on Brazilian Areas of High Natural Radiation. 1967. NYO-3273-9; 125 p. (Brazil University, Instituto de Biofisica, Rio de Janeiro, Brazil)

Studies were conducted in three Brazilian areas of high natural radioactivity: Guarapary-Maiepe in the monazite sand region Araxa, and Morro do Ferro, both located in areas of volcanic intrusives. Body burdens of Ra 226 and Ra 228 were estimated in selected individuals receiving known doses of external radiation within the range of 0.5 to 2.0 rad/yr in the monazite sand area. The frequency of somatic chromosome aberrations was estimated in selected individuals with higher than normal radium and thorium body burdens in the Araxa area. Radioecological studies are being conducted at Morro do Ferro. (NSA)

<970>

Penna-Franca, E., Radioactivity in the Diet of the Inhabitants of the Brazilian Regions of Elevated Natural Radiation. 1968. NP-18670; 163 p. (Brazil University, Instituto de Biofisica, Rio de Janeiro, Brazil)

Studies are reported on populations dwelling on high natural radioactivity areas in Brazil. Two such areas studied included the monazite sand region, along the coast of the State of Espirito Santo, and the volcanic intrusive anomalies, in the State of Minas Gerais. The main objective of the study was to evaluate the extent of the radioactive intake and internal contamination of the selected populations in both regions, in order to determine whether biological effects of ionizing radiation could be identified and investigated. Two villages were surveyed in the monazite sand region: Guarapary and Maiepe. The local production of food was found to be significant and their radioactive contents were practically within normal ranges. No statistically significant differences were observed between average Ra 226 and Th 228 contents in teeth and placenta from inhabitants of the two villages and controls. External beta and gamma radiations from the soil are the main source of human irradiation in the region. Inhalation of dust and thoron and daughter production, are secondary sources of irradiation. In the State of Minas Gerais, the villages of Tapira and Barreiro, near Araxa, were selected for

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having extensive agriculture production cultivated, to a large extent, in radioactive soil. A complete survey of the radioactive contamination of local produce demonstrated high Ra 226 and Ra 228 contents in many types of foodstuff, reaching in some cases two orders of magnitude above average normal values. A dietary inquiry was conducted in a representative sample of the population which led to classify the inhabitants in groups, according to certain ranges of radioactive intake. The inquiry demonstrated that the internal radioactive contamination of the local population was of less magnitude than the levels in food had indicated. Only 12% of the inhabitants had daily intake of alpha emitters above five times the average in normal regions. Analyses of Ra 226 and Th 228 in teeth and placenta were carried on concomitantly, as a sensitive method for the detection of people with above average radium body-burdens. Body burden in these individuals will be measured using whole-body counters. Considering the relatively low levels of external and internal radiation doses to which the inhabitants of the surveyed areas are exposed, and also the small size of the population, it was concluded that the only biological effect of radiation that could possibly be of significance would be chromosome aberrations. (NSA)

<971>

Penna-Franca, E., M. Fiszman, N. Lobao, H. Trindade, P.L. Santos, and C. Costa-Ribeiro. Radioactivity in the Diet in High Background Areas of Brazil. 1970. Health Physics, 19, 657-662 (Brazil University, Instituto de Biofisica, Rio de Janeiro, Brazil)

Two types of high background regions have been studied in Brazil- the monazite sand region along the Atlantic Coast and the zone of volcanic intrusives in the inland state of Minas Gerais. In both regions there are groups of people living on variable fields of radiation ranging from 0.03 to 1.0 m R/hr. To evaluate the extent of the radioactive intake and internal contamination of representative populations, an extensive survey was carried out. In villages in the monazite sand region, the local production of food was found to be insignificant and the radioactive contents were practically within normal ranges. In the volcanic intrusive zone, two villages were selected for having extensive agriculture production cultivated, to a large extent, in soils containing thorium and uranium minerals. The radioactivity in local produce is appreciable, mostly due to Ra 228 and daughters, which in some types of foodstuff reach two orders of magnitude above average normal values. A dietary inquiry conducted in a representative sample of the population allowed the classification of the inhabitants in groups, according to certain ranges of radioactive intake. In spite of the high levels in some local foods, mostly root vegetables, only 18 percent of the inhabitants presented daily intakes of alpha emitters above 5 fold the average in normal regions. The maximum daily intake observed was elevated by a factor of 20. For the high intake group, the estimated Ra 228 body-burdens were in the range of 1-3 nCi. (Auth)

<972>

Penna-Franca, E., M. Fiszman, N. Lobao, C. Costa-Ribeiro, H. Trindade, P.L. Dos Santos, and D. Batista. Radioactivity of Brazil Nuts. 1968, February. Health Physics, 14, 95-99 (University, Rio de Janeiro, Instituto Nacional de Pesquisas

do Amazonas, Manaus, Brazil)

It has been known for some time that Brazil nuts have a high barium content and their natural radioactivity is the highest among foodstuff grown in areas of normal radiation background. Samples of Brazil nuts of known origin, as well as various parts of their trees, were obtained from different regions of the Amazon valley and analyzed for barium, calcium, Ra 226, and total alpha activity. No statistically significant correlation was found between concentrations of calcium and barium in the nuts. In general, however, the samples richer in barium had the highest concentration of radium. In samples of different parts of the same tree a certain parallelism was noticed between barium and radium contents. The high radioactivity of Brazil nuts was explained, in agreement with the opinion of other authors, by its tree capacity of absorbing and concentrating barium, which is the natural carrier of radium. Some observations were made on the possibilities of people who consume a considerable amount of the nuts, during many years, building up elevated radium body burdens. (Auth)

<973>

Pensko, J., T. Wardaszko, and M. Wochna, Natural Atmospheric Radioactivity and Its Dependence on Some Geophysical Factors. 1968, June. Atompraxis, 14, 255-258 (Central Laboratory for Radiological Protection, Warsaw, Poland)

Observations were made on the dependence of natural gamma radiation background and Ra 222 concentration on various environmental factors. Differences between daily mean values of radon exhalation from soil greater than one order of magnitude were noticed, and cannot be explained on the basis of the instability of the diffusion factor. These differences are probably caused by variation of water or ice content in the soil influencing the mechanism of radon diffusion. From observation of the soil freezing effect on radon exhalation it may be supposed that the radon diffusion factor is considerably greater in ice than in water. In the period of soil-water freezing, the vertical distribution of radon concentration is quite different from that in normal conditions. (Auth)

<974>

Perkins, R.W., and J.M. Nielsen, Zinc 65 in Foods and People. 1959. Science, 129, 94-95 (Hanford Laboratories Operation, Richland, WA)

Disposal of trace amounts of Zn 65 is made in the Columbia River via Hanford reactor effluent water. The subsequent utilization of river water for irrigation permits the concentration of this radioisotope in farm produce and its eventual deposition in man. The Zn 65 in irrigation water, in farm produce, and in individuals utilizing these materials has been measured. (Auth)

<975>

Perrin, F., Experimental Study of the Radioactive Contamination of Cultures, Especially by Irrigation Water. 1963. Compt. Rend. Acad. Agr. France, 49, 611-620

The relation between the rate of contamination of the natural milieu and that of plants was defined in order to determine if the rate of soil contamination would remain slow so that the threshold of toxicity would never be reached in foodstuffs. Strontium 90 or Cesium

<975> CONT.

137 was applied in solution in relatively high doses to soils of various types, and the fraction of radioactivity of each element in different cultivated plants was determined. Ratios were determined for the radioelement in 1 kg of harvested food/ radioelement in 1 liter of irrigation water. The results obtained for grapes, fescue, and vegetables were tabulated and discussed. They indicate that the maximum permissible concentration should be higher for irrigation water than for drinking water. (NSA)

<976>

Peters, L.N., J.S. Olson, and R.M. Anderson, Eight-Year Summary of Plant-Soil Data on Cesium 137 in a Tagged Appalachian Forest Dominated by LIRIODENDRON TULIPIFERA. 1969. ORNL-TM-2737; 235 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

A long-term tracer experiment using Cs 137 was initiated May 20-23, 1962. The experimental site was located on the AEC Reservation, Oak Ridge, Tennessee, in a forest dominated by tulip poplar (LIRIODENDRON TULIPIFERA). The trees in an area of 20 to 25 meters were tagged with 464 microcuries of Cs 137. In the autumn immediately after inoculation, approximately 63 percent had transferred to the ground (0 to 30 cm, including litter) inside and outside the tagged area. Rainfall accounted for four percent of the ground burden and litter fall about 12 percent; therefore, roots must have contributed approximately 84 percent of the cesium concentration in the soil. Almost all of the cesium was immediately bound within the soil. By 1967 the total amount accumulated in the soil and litter was 96% (plus or minus 5% S.E.) of initial inoculum. Continuous sampling of canopy parts indicated a relatively steady decline of Cs 137 concentration in leaves. There was no evidence of recycling of Cs 137 from roots. Numerous amounts of data have been collected since the tagging of the forest. This report constitutes a depository of data on amounts and rates of transfer of Cs 137 in the tulip poplar forest. (Auth)

<977>

Peters, L.N., and J.P. Witherspoon, Retention of 44-88 Micron Simulated Fallout Particles by Grasses. 1972. Health Physics, 22, 261-266 (Oak Ridge National Laboratory, Ecological Sciences Division, Oak Ridge, TN)

A quartz fallout simulant containing Cs 134 was deposited (1.85 g particles/ft²) on 4 common species of grasses used for pasture or turf purposes (Zoysia, Bluegrass, Fescue and Bermuda). Initial interception of the fallout simulant varied between species from 68 to 82 percent. Weathering half-lives of particles of foliage average 3.5 plus or minus 0.6 S.E., 36.7 plus or minus 8.6 S.E. and 80.5 plus or minus 39.5 days, respectively, for time periods of 0-2.5, 2.5-35 and 35-48 days following deposition. Particles lost from foliage were mostly trapped by dense mats of stem and dead foliage, and transfer of particles to the soil surface amounted only to 31 percent of the original deposition at 48 days. Thus fallout contaminated grasses might be expected to receive greater radiation doses and retain more radioactivity for food chain transfers than other agricultural plants with less effective structures for particle retention. (Auth)

<978>

Phillips, R.E., and D.A. Brown, Ion Diffusion II, Comparison of Apparent Self and Counter Diffusion Coefficients. 1964. Soil Science Society of America Proceedings, 28, 758-763 (University of Arkansas, Agricultural Experiment Station, Department of Agronomy, Fayetteville, AK)

The experimental distributions of Rb 86 diffusing in soil materials are obtained using a quick-freeze method. The calculation of apparent diffusion is presented for the following geometries: 1) self diffusion and 2) counter diffusion of Rb diffusing from soil media initially saturated with Rb into the same soil media initially saturated with H (I). The distribution of Rb 86 counter diffusing from kaolinite clay, montmorillonite clay, Sharkey clay soil and Dundee silt loam soil pastes into H (I) saturated kaolinite, montmorillonite, Sharkey and Dundee pastes can be characterized using self diffusion theory. The order of magnitude of apparent self diffusion coefficients is larger than those for counter diffusion in each of the four soil materials. The order of magnitude of the rate of Rb diffusion in the four soil materials is as follows: kaolinite clay > Dundee silt loam soil > Sharkey clay > montmorillonite clay. The values of the diffusion coefficients range from $3.9 \times 10^{(E-7)}$ cm²sec^(E-1) to $24.3 \times 10^{(E-7)}$ cm² sec^(E-1). Qualitative apparent counter diffusion coefficients of Rb diffusing from soil media initially saturated with Rb into strong acid exchange-resin discs initially saturated with H (I) are also presented for qualitative comparison purposes. (Auth)

<979>

Pinkas, L.L.H., and L.H. Smith, Physiological Basis of Differential Strontium Accumulation in Two Barley Genotypes. 1966. Plant Physiology, 41, 1471-1475 (University of Minnesota, Department of Agronomy and Plant Genetics, St. Paul, MN)

Studies of rates of Sr transport from nutrient solutions containing 8 concentrations of Sr indicate a definite trend towards higher rates of Sr transport by roots of intact 12-day-old Regal barley (HORDEUM VULGARE, L.) seedlings as compared with Tregal. Differences in rates of Sr transport between the 2 varieties were also indicated by higher concentrations of Sr in fluids exuding from decapitated Regal roots. No differences between Regal and Tregal were found in the physical factors of distance from epidermis to endodermis, number of cortical cell layers, or transpiration rate. Furthermore, no relationship was observed between transpiration rate and rate of Sr accumulation. Dependence of Sr transport on metabolic processes was indicated by marked effects of temperature, cyanide, and dinitrophenol on rates of Sr transport. Q10 values for Sr transport by Regal and Tregal approached 2, thereby indicating that metabolic reactions were associated with this process. Strontium transport by both Regal and Tregal was markedly depressed in the presence of either cyanide or dinitrophenol. These results led to the conclusion that the Sr transport process is dependent on metabolic energy derived from respiration. (Auth)

<980>

Pisarev, V.V., I.A. Koloskov, V.M. Kuznetsova, and I.S. Tsybizov, Leaching of Strontium 90 From Soil by Surface Water. 1972. Soviet Soil Science, 4, 193-201 (Institute of Applied Geophysics, Moscow, USSR)

<980> CONT.

The results of studies on the leaching rate of strontium 90 from soil by meltwater, rainwater, and ephemeral streams are analyzed. Experiments were performed under natural conditions on plots measuring 1 x 1 m to whose surface soluble strontium 90 compounds were applied previously. The coefficients of decontamination of the soil by surface water (ratio of the amount of strontium removed to the amount before leaching) were found to be close for the different kinds of surface water, averaging 0.62% a yr for soils contaminated 2 yrs and 0.16% a yr for soils contaminated 10 yrs. (Auth)

<981>

Piskunov, L.I., An Incorrect Relationship between the Buildup of Strontium 90 and Cerium 144 in Freshwater Plants. 1969, October 1. Dokl. Akad. Nauk SSSR, 188, 917-919

Freshwater plants possess relatively high buildup factors for radionuclides. The statistical correlation of these factors was examined by studying the buildup of Sr 90 and Ce 144 on the basis of previously published data, on Sr K and Ce K. An inverse dependence was established by means of the statistical treatment of the results obtained by correlative and regressive analyses using the least-squares method. The thus confirmed mutual dependence of the buildup factors of the two elements by two groups of fresh water plants indicates that in the biocenosis the microelements Sr and Ce must be considered as antagonists. (NSA)

<982>

Piskunov, L.I., and S.I. Treiger, Discrimination of Strontium 90 with Respect to Calcium in Freshwater Plants. 1970. Radiobiologiya, 10, 788-790 (Sverdlovsk Regional Sanitary-Epidemiological Station, USSR)

The results of a statistical treatment of the published data of laboratory experiments on the accumulation and discrimination of Sr 90 in freshwater plants as a function of the calcium concentration in the water are discussed. The viewpoint that the discrimination coefficients depend on the calcium concentration in the surrounding water was confirmed. (tr-Auth)

<983>

Place, G.A., and S.A. Barber, The Effect of Soil Moisture and Rubidium Concentration on Diffusion and Uptake of Rubidium 86. 1964. Soil Science Society of America Proceedings, 28, 239-243 (Purdue University, Agriculture Experiment Station, Lafayette, IN)

An autoradiographic technique was used to study the effect of soil moisture and Rb concentration on Rb 86 diffusion and uptake by corn plants. Changes in soil moisture influenced the rate of diffusion, rate of root elongation, and the incidence of root hairs. The self-diffusion of Rb 86 was linearly correlated ($R(E+2)=0.89$) positively with soil moisture, Rb concentration, and interaction of these two factors. The correlation of Rb 86 uptake from the soil was positively correlated with Rb 86 diffusion values approximated from measurements made of the depleted areas about the roots. When the root diameter used in the calculation included the length of the root hairs, the $r(E+2)$ was 0.70 and when the root hairs were not included the $r(E+2)$ was 0.56. The correlation of uptake with the values of Dp/b from self-diffusion studies gave an r

($E+2$) of 0.99. Uptake by roots without root hairs was linearly correlated ($r(E+2) = 0.98$) with soil moisture, Rb concentration, and their interaction. Since the uptake relationships were similar whether or not the roots possessed root hairs, it was concluded that moisture's effect on rate of diffusion was of greater significance in its effect on Rb 86 uptake than was its effect on root hair incidence in these experiments. (Auth)

<984>

Plamondon, J., Rapid Determination of Uranium in Geochemical Samples by Paper Chromatography. 1968, January - February. Economic Geology, 63, 76-79 (Canada Department of Natural Resources, Quebec, Canada)

Concentrations of uranium as low as 1 ppm are determined in soils and sediments by ascending paper chromatography, subsequent to a hot nitric acid attack of the samples. The reagent 1-(2-pyridylazo)-2-naphthol (PAN), which is used to develop the chromatograms, is capable of detecting 0.05 gamma of uranium. The method is rapid and inexpensive. (Auth)

<985>

Plato, P.A., Predicting the Movement of a Radionuclide through Soil. 1968. Ph.D. Thesis; 154 p. (State University of Iowa, Iowa City, IA)

A method for predicting the rate of movement of a simple waste through soil was developed. The waste material selected was strontium, an important constituent of many radioactive liquid wastes because of its chemical similarity to calcium which is an element that is used in the synthesis of teeth and bones. Soil columns were used in which flow moved in one direction, and a soil tank was used in which flow moved in the horizontal and vertical directions away from a modeled waste seepage pit. In an attempt to obtain more reproducible results in examining the mechanisms responsible for the movement of strontium through soil, a cation exchange resin was used to simulate the soil. Stable calcium was substituted for radiostromium which resulted in an analytical technique for measuring cationic concentrations which was faster than determining the concentrations radiochemically. An equation, which accurately predicted the movement of calcium through the ion exchange resin was developed, and incorporated the flow rate through the resin, the concentration of the influent solution, and the resin bed depth. However, the equation did not prove to be applicable in predicting the movement of cations through soil due to the relatively large time required for the cations to diffuse into the soil particles. An empirical equation was developed which tended to describe the results obtained when calcium solutions were passed through soil columns. A design of a field study based on the empirical equation was suggested. (Auth) (NSA)

<986>

Plummer, G.L., Fallout Radioisotopes in Georgia Lichens. 1969. CONF-670503; Part of Nelson, D.J. and Evans, F.C. (Eds.), Proceedings of the Second National Symposium on Radioecology, held in Ann Arbor, Michigan, May 15-17, 1967, (p. 571-577), 774p. (University of Georgia, Department of Botany, Athens, GA)

Concentration values for 9 radioisotopes were studied in three lichens that may be ecologically equivalent to similar taxons inhabiting parts of the arctic tundras.

<986> CONT.

Treatments with as much as 500 nCi of Cs 134 per square meter showed no significant loss of radiocesium after lichens were leached with heavy rainfall. The results suggest that CLADONIA particularly, with a capacity to concentrate an undetermined limit of Cs 137, may incorporate all the radiocesium that might be expected from fallout debris. (Auth) (CWF)

<987>

Plummer, G.L., D.A. Crossley, Jr., and D.A. Gardiner, Growth Response of Two Sedges Inhabiting a Radioactive Waste Disposal Area. 1965. Ecology, 46, 346-348 (Oak Ridge National Laboratory, Oak Ridge, TN)

An observed increase in the size of the inflorescences of two sedges inhabiting a radioactive waste disposal area is correlated with the complex interaction between various edaphic factors that contribute to plant growth and an "effect" of ionizing radiation. The perennial sedges, CAREX FRANKII and CAREX VULPINOIDEA, tolerate a continuous dose rate generally in excess of 2 R/day at ground level. Although radiation has been associated with excessive plant growth, it is not entirely independent of other factors, such as the combined contribution of potassium and organic matter, soil pH, calcium, as well as other unmeasured edaphic conditions. (Auth)

<988>

Poelstra, P., and M.J. Frissel, Migration of Water and Ions in Undisturbed Soil Columns and Its Description by Simulation Models. 1967. STI/PUB-158; CONF-670641; Part of Proceedings of a Symposium on the Use of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies held in Istanbul, Turkey, June 12-16, 1967, (p. 203-210) (Euratom-Ital, Wageningen, Netherlands)

A description is given of the technique of taking 100-cm-high and 12-cm-dia soil columns without disturbing the natural build-up of the profile, the rain installation, controlled by an automatic device, that enables fluxes from 0.05 ml cm⁻² d⁻¹ to 20 ml cm⁻² d⁻¹, and supplies the water in drops of about 0.04 ml. In this installation 25 columns can be handled simultaneously at five different flow-rates while 10 different solutions can be used for leaching; the columns scanner specifically developed for measuring the distribution pattern of the labeled compound in the column; and the results of several leaching experiments in a podsol soil with tritiated water and solutions of strontium- and calcium-labeled CaCl₂ at different flow-rates and concentrations. As soil is a heterogeneous system it is not possible to describe the migration by the usual chromatographic theories such as those of Glueckauf or Hiester and Vermeulen. The mathematical description, therefore, is done by simulation models. In these models the calculation is carried out step by step by a computer whereby the conditions are varied as necessary after each step. Several models that have been tested are described and compared with experimental results. (Auth)

<989>

Poelstra, P., and M.J. Frissel, Strontium 90 Contamination of Grass, Based on Some Ecological Parameters. 1972. EUR-4800; Part of Proceedings of an International Symposium on Radioecology Applied to the Protection of Man and His Environment held in Rome, Italy, September 7, 1971, (p. 1039-1056) (Euratom, Wageningen, Netherlands)

Radioecology aims to investigate the behavior of microquantities of radioactive material in the ecosystem, as fallout and activation products. These investigations should be carried out in a way that they may contribute to the prediction of the behavior of these products in the ecosystem. Such an investigation is described for the fallout product Sr 90, resulting in the calculation of the Sr 90 contamination of grass based on some ecological parameters. The investigation is carried out on 12 permanent pastures, situated throughout the Euron countries. Both soil and grass were annually sampled from 1958 till 1969, the soil in layers of 5 cm up to 25 cm. All samples are analyzed for Sr 90 and Ca. Based on a number of physicochemical considerations and using a computer, an equation was derived in order to calculate the Sr 90 contamination of the grass related to the accumulated Sr 90 in the soil, the Sr 90 deposition rate and a number of climatological, physiological, and soil parameters. (Auth)

<990>

Poelstra, P., and M.J. Frissel, Investigation on Strontium 90 Fallout in the Netherlands over the Period 1958-1965. 1967, April. Landbouwk. Tijdschr., 79, 100-105 (Euratom-Ital, Wageningen, Netherlands)

Each spring since 1958 soil and grass samples were taken from four different soil types with differing Ca contents in permanent meadows and the fallout Strontium 90 and Ca were determined. The quantity of Strontium 90 measured in the soil was compared with the Strontium 90 deposited as fallout. The measurements suggest that the deposition of Strontium 90 over the profile occurs faster when the Ca content is higher. (tr-Auth)

<991>

Poelstra, P., M.J. Frissel, and P. Reiniger, Influence of Soil pH on the Fallout Strontium 90 Contamination of Several Crops in Situ. 1970. CONF-690918-(Vol. 2); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 689-706), 506p. (Euratom, Wageningen, Netherlands)

The influence of soil pH on the Strontium 90 contamination of crops was investigated on an experimental field at three pH levels, 3.5, 4.2 and 5.0. Soil and crops were sampled once a year during a period of six years and analyzed for Ca and Strontium 90. On soil samples, taken from the top 20-cm layer, the exchangeable Ca and total Strontium 90 content were determined. Crop samples were taken from the consumable parts just before harvesting and analyzed for total Ca and Strontium 90. Crops investigated include oats, rye, barley, wheat, peas, clover, ryegrass, potatoes and beets. A multidimensional calculation was set up to determine for each crop the yearly Strontium 90 contamination originating, respectively, from soil and from air. Total contamination was calculated as a function of soil pH, of Strontium 90 amount in the soil of Strontium 90 deposition rate, and of additional soil and crop parameters. Calculations were made with an electronic computer. Results show clearly the influence of soil pH on Strontium 90 contamination. In many cases it was twice as high at pH 3.5 than at pH 5.0. For many crops the direct foliar contamination (originating from the air) was up to 80 percent of the total contamination in 1963 and about 10 percent in 1967. (Auth)

<992>

Polgar, E., and C. Kurczne, Determination of Radioactive Strontium Content in Fallout and Mud Samples. 1968, June. May, Kem. Lapia, 23, 341-343

Some experiments are presented which were performed for the determination of the Sr 90 contents of the fallout and of some mud samples. A method, formerly used for the determination of the active Sr content of atmospheric rainfall, was modified. Using this modified procedure the investigations, which would be otherwise rather laborious, can be performed rather simply and within a relatively short time. (Auth)

<993>

Polikarpov, G.G., V.I. Timoshchuk, I.A. Sokolova, and V.P. Parchevskii, Strontium 90 in the Danube River and the Adjacent International Zone of the Black Sea, A Radioecological Study. A-AC-82/G/L-1243; AEC-tr-7128; (p. 6-13) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

The Sr 90 and Y 90 content of fresh and seawater samples and ashed plankton of Danube River organisms was determined. Between the periods 1961-63 and 1966-67 the Sr 90 content of the water increased. The Sr content of several Black Sea organisms as a function of time is given. It is concluded that a complete isotopic exchange between Sr 90 and stable Sr in the Black Sea plants and animals takes place. (ST)

<994>

Polyakov, Yu.A., Sorption of Strontium and Calcium Ions by Soils. 1959. Colloid Journal (USSR), 21, 205-209 (Academy of Sciences, The V.V. Dokuchaev Soil Institute, Moscow, USSR)

The authors used thermodynamic calculations involving the relative adsorption of strontium and calcium to clays to predict what the "observed ratio" of the two ions would be in the plant providing the plant did not discriminate between the two ions. They predicted it to be less than one in all cases (0.8 - 0.9). (CWF)

<995>

Polyakov, Yu.A., Determination of Thermodynamic Characteristics of the Exchange Adsorptions of Calcium and Strontium Ions in Soils. 1960. Dokl. Sovet. Pochvovedov 7 mezhdunarod. Konqr., 100-105

The main thermodynamic characteristics (ΔH , ΔF , ΔS) of the exchange reactions between Ca (II) and Sr (II) in soils and clays were determined. The values confirm the isoenergetic character of the reaction and show a greater stability of the system soil-Ca than of the system soil-Sr. The discrimination coefficient of Sr 90 in the system soil-plant was less than 1.0. (Auth)

<996>

Polyakov, Yu.A., Reactions Between Soils and Calcium and Strontium Ions. 1960. Soviet Soil Science, 7, 100-105 (Soil Institute, Moscow, USSR)

The exchange reaction between Ca and Sr ions in soils and clays was investigated. The main thermodynamic characteristics were determined. The numerical values of ΔH , ΔF , ΔS confirmed the isoenergetic character of the reaction in question; they also indicate that the adsorption system-soil-Sr from a thermodynamic

point of view is more stable than soil-Ca. The data obtained were used for calculating the most probable value of the discrimination coefficient (DC) Sr 90 in the system soil-plant. The numerical value of DC in all cases investigated was found to be less than 1, with a variation from 0.8 to 0.9. (Auth-tr)

<997>

Polyakov, Yu.A., V.F. Gol'tsov, and V.G. Grakovskii, The Diffusion of Strontium 90 in Soils. 1969. A-AC-82/G/L-1242; AEC-tr-7030; Part of USSR Reports on Natural and Fallout Radioactivity, (p. 14-25) (Not given)

A study was made of strontium 90 ions in gray forest soils, black earth soils and alluvial soils. It was demonstrated that the numerical values of the diffusion coefficient depend upon the properties of the soils and that these values range between 0.6×10^{-7} (for black earth) and 20×10^{-7} cm²/sec (alluvial soils). The diffusion coefficient can be regarded as constant only in cases in which soil samples are prepared in such a way as to create systems which are more or less homogeneous as regards properties (pastes, suspensions). In all other cases, and particularly when strontium 90 is studied under natural soil conditions, the diffusion coefficient must be regarded as being variable. Even here, however, Fick's equation can be used in calculating the value of D. In our research we developed a method for preparing soil samples and a method for solving Fick's equation; these, we believe, can be used not only for the study of strontium 90 diffusion in soils, but also for that of other ions. (Auth)

<998>

Polyakov, Yu.A., G.M. Kader, and V.V. Krinitskii, Behavior of Strontium 90 and Cesium 137 in Soils. 1973. Part of Klechkovskii, V.M. (Ed.), Radioecology, John Wiley and Sons, Inc., New York, New York, (p. 78-102), 381 p. (Not given)

The forms of Sr 90 and Cs 137 compounds in soils and the impact on the behavior of these nuclides of the water factor, absorption capacity, complex formers, diffusion, and ion exchange are reviewed. Other topics discussed are energy characteristics of ion exchange reactions of the analog element, Sr 90 and Cs 137 discrimination in different stages of the ecological cycle, effects of various cations, significance of complexants, field determination of diffusion coefficients, exchange of Sr and Ca ions in soils and clays, and exchange sorption of Cs (+1) and Sr (+2) ions on resins. (NSA)

<999>

Polyakov, Yu.A., L.N. Kalishina, and L.F. Nazorova, Distribution of Strontium 90 in the Soil Profile in the Moderately Northern Latitudes of the USSR. 1967. CONF-660405; Part of Aberg, B. and Hunkate, P.F. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, (p. 39-41), 1051p. (Dokuchaev Soil Institute, USSR)

From 1958 through 1965, a study was made of the accumulation and distribution processes of Sr 90 in the profile of soils located in the moderate-northern latitudes of the USSR. It was shown that Sr90 distribution in the profile of silty-sandy podzolic soils was largely determined by physico-geographical environmental conditions, such as

<999> CONT.

physico-chemical and genetical soil properties, soil-solution reaction, precipitation rate, and by many undetermined factors. Sr 90 fallout has moved by leaching from the upper horizons of soils to the horizons of maximum root-system occurrence, and hence, the soil contribution has become much more important in the uptake of Sr 90 by plants from the environment. If Sr 90 fallout is sufficiently high, the bulk of this nuclide will tend to concentrate in two zones: in the upper horizons and alluvial-depth horizons. (Auth) (CWF)

<1000>

Polzer, W.L., Solubility of Plutonium in Soil/Water Environments - A Theoretical Study. 1971. CONF-710401: Part of Rocky Flats Symposium on Safety in Plutonium Handling Facilities held in Golden, Colorado April 13, 1971, (p. 411-429) (Idaho Operations Office, Health Services Laboratory, Idaho Falls, ID)

The phase relations of the various plutonium species, both solid and aqueous, are evaluated as a function of hydrogen ion concentration (pH) and oxidation-reduction potential (Eh) for conditions normally found in soil/water environments. The evaluation is based on theoretical considerations and laboratory data obtained from the literature. Concentrations of dissolved plutonium are calculated from the evaluated phase relations. The significance of plutonium complexes on the concentration of dissolved plutonium is discussed and the effect of plutonium carbonate on dissolved plutonium evaluated. (Auth)

<1001>

Pomeroy, L.R., E.P. Odum, R.J. Reimold, R.D.H. Jones, and L.R. Shenton, Field Experiments on the Flux of Radionuclides Through a Salt Marsh Ecosystem, Progress Report.. 1969. ORO-3238-7; 24 p. (University of Georgia, Department of Zoology, Athens, GA)

During the 1969 contract year the flux of P 32 from the sediments through SPARTINA ALTERNIFLORA, and its subsequent release into the salt marsh ecosystem were evaluated. Related field experiments have been concerned with the flux of P 32, Zn 65, Sr 90, and Fe 59 through the five compartments identified in our mathematical model. Mathematical modeling efforts have been directed toward digital, analog, and digital-analog hybrid computer solutions as well as analytical solutions. Effects of inputs and outputs in the five compartment model have been considered as well as the effect of perturbations of the standing stock values. The model appears to respond closely to natural environmental measurements and consequently can be expanded in complexity to include a greater number of compartments and nonlinear flux rates. (Auth)

<1002>

Porter, L.K., W.D. Kemper, R.D. Jackson, and B.A. Stewart, Chloride Diffusion in Soils as Influenced by Moisture Content. 1960. Soil Science Society of America Proceedings, 24, 460-462 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Beltsville, MD)

Chloride diffusivities were measured in medium- and fine-textured soils at moisture tensions from 1/3 to 15 atm. Chloride diffusivities obtained from the soil systems were divided by the diffusivity of chloride in water to obtain transmission factors. These

factors varied from 0.310 to 0.027 depending on the soil moisture content and soil texture. The results were interpreted in terms of volumetric moisture content, effective path length factors and clay-water interactions. (Auth)

<1003>

Price, K.R., Uptake of Neptunium 237, Plutonium 239, Americium 241, and Curium 244 from Soil by Tumbleweed and Cheatgrass. 1972. BNWL-1688; 14 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Tumbleweed (SALISOLA KALI) and cheatgrass (BROMUS TECTORUM) were grown under controlled conditions in pots containing surface soil common to radioactive waste disposal sites at Hanford. The soil was spiked with $\text{Np } 237$, $\text{Pu } 239$, $\text{Pu } 241$, $\text{Am } 241$, $\text{Am } 243$, or $\text{Cm } 244$ in HNO_3 solutions, and all radionuclides were absorbed by the test plants. Large amounts of neptunium were taken up (>2% dose), with smaller amounts of americium and curium. Plutonium uptake was only slight. Critical levels of detection (1 sub C) are calculated, and the term Minimum Soil Detection Level (1 sub MSD) is introduced. The application of results to waste management is discussed. (Auth)

<1004>

Price, K.R., A Critical Review of Biological Accumulation, Discrimination and Uptake of Radionuclides Important to Waste Management Practices 1943-1971. 1971, December. BNWL-B-148; 67 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Ecosystems Department, Richland, WA)

The objective of this survey is to screen the world literature for data on biological uptake and accumulation or the discrimination against uptake of certain radionuclides associated with nuclear waste management. Historical aspects based on the publication sequence of biological research are briefly considered, and relevant research findings are discussed under several categories. One category is devoted to transuranic elements and is accompanied by a special bibliography. The application of research findings to the Hanford situation is discussed and projects for future study are recommended. An annotated list of 119 references is presented. (Auth)

<1005>

Price, K.R., Tumbleweed and Cheatgrass Uptake of Transuranium Elements Applied to Soil as Organic Acid Complexes. 1973, May. BNWL-1775; 10 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Ecosystems Department, Richland, WA)

Plant uptake of radioactive waste materials is a biological interaction important to the environmental management of waste storage sites. This study on the uptake of transuranium elements from soil by plants demonstrates that shoot uptake is clearly influenced by the chemical form of the transuranic. It is unclear at this time whether soil or plant mechanisms, or both, are responsible. Future studies are planned to investigate these aspects. The observation that some organic acids suppress plant uptake of americium and curium will be investigated further to evaluate the use of soil additives to suppress plant uptake of transuranics. Test results indicate that organic acid complexes of plutonium such as oxalate or citrate can increase plant uptake when added

<1005> CONT.

to soil as compared to uptake from dilute nitric acid solutions. (Auth)

<1006>

Prister, B.S., Behavior of Uranium in the Biologic Chain. 1970, April 15.
A-AC-82/G/L-1298; AEC-tr-7128; (p. 194-27)
(Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

Field experiments on the accumulation of uranium in basic crops were carried out for three years on a large tract of land. Crops included grains, legumes, root crops, and vegetables. Measurements of the uranium content of the soil were made by extracting uranium with nitric solutions. A formula is presented for determining the coefficient of accumulations, or relative capacity of plants to accumulate uranium. Values for these coefficients are tabulated for grains, legumes, root plants, and vegetables. Data on accumulation of uranium in tissues of chickens and swine are tabulated. Studies on concentration of uranium in dairy products showed that the content of butter and cheese was eight times as great as that of milk. Data on uranium content of the human diet showed that more than half the uranium reached man through products of vegetable origin. Food products of animal origin contributed 28 percent of uranium to man. (NSA)

<1007>

Prister, B.S., and S.S. Prister, Effects of Uranium on the Growth and Development of Plants and its Accumulation as a Function of the Content in the Germination Medium. 1970.
Radiobiologiya, 10, 138-140

It was found in greenhouse experiments that U at a dose of 200 $\mu\text{g}/\text{kg}$ of sand was nontoxic for plants. For a water culture a 50 $\mu\text{g}/\text{liter}$ dose of U results in death of corn plants on the fourth day. The relation between the accumulation of U by the plants and its content in the medium was a decreasing exponential function. With increasing U concentration in the roots, intake into the aboveground portion of the plants decreased. (tr-Auth)

<1008>

Prokhorov, V.M., The Role of Diffusion in the Migration of Radioactive Contaminants. 1965.
At. Energ. (USSR), 18, 796

Diffusion data of strontium 90 in soils under laboratory conditions are utilized to predict the vertical movement through a soil profile. (CWF)

<1009>

Prokhorov, V.M., Kinetics of Adsorption of Strontium 90 on the Bottom of Confined Water Basins. 1969. Radiokhimiya, 11, 317-325

It is shown that the kinetics of adsorption of Sr 90 from water confined in a basin is determined (with the exception of a small initial period) by the actual rate of diffusion of Sr 90 in thick bottom deposits. Adsorptive equilibrium of Sr 90 between water and the bottom of the reservoir could not be proved. Formulas were developed that permit, without the utilization of empirical magnitudes, the forecasting of the concentration of Sr 90 in water and in the bottom deposits for any moment from known concentrations for other times. (tr-Auth)

<1010>

Prokhorov, V.M., Diffusion of Strontium 90 in Soil and Sand. 1961. Soviet Radiochemistry, 4, 183-188

A differential equation was derived for diffusion in a polyphase adsorbing medium. It was shown that in the case of a linear adsorption isotherm, the diffusion coefficient does not actually depend on concentration. The numerical values for the diffusion coefficient of Sr 90 in a strongly sorbing soil and in quartz sand were found at various moisture contents and it was established that the experimental data agree with theoretical equation derived. The possibility of investigating the adsorption properties of media by measuring diffusion rates was demonstrated. It was found that the distribution coefficient of Sr 90 was considerably less in moist soil than in an aqueous suspension of the same soil. (Auth)

<1011>

Prokhorov, V.M., Relationship Between the Diffusion Rate of Strontium 90 and Soil Moisture Content. 1965. Soviet Soil Science, 10, 1184-1186 (Research Institute of Agricultural Physics, USSR)

In the three samples of Sod-Podzolic soil, the Sr 90 diffusion rate was lowest in the one containing the highest values of the exchange capacity, specific surface area, and humus content. In two samples, one of which had higher exchange capacity and specific surface area values while the other had a higher humus content, Sr 90 diffused with the rates coinciding within large moisture intervals. (Auth)

<1012>

Prokhorov, V.M., Ion Diffusion in an Adsorbing Dispersion Medium. 1963. Colloid Journal (USSR), 25, 50-54 (Agrophysics Institute, Leningrad, USSR)

The derivation is given for the differential equation of diffusion in a polyphase adsorbing medium with variable cross section of the conducting phase. Measurements are made of the numerical values of the diffusion coefficient in three types of soils and in quartz sand at different humidities. The distribution coefficient of Sr 90 in moist soil is considerably less than in a soil suspension. (Auth)

<1013>

Prokhorov, V.M., Ion Diffusion in Soils and Its Role in Radionuclide Migration. 1973. Part of Klechkovskii, V.M. (Ed.), Radioecology, John Wiley and Sons, Inc., New York, New York, (p. 103-125), 381 p. (Not given)

The role of ion diffusion in radionuclide migration in soils is reviewed. The complex nature of migration in soils is emphasized and the effects of biological transport processes, climatic factors, and human economic activities are discussed. Special features of radionuclide diffusion in soil, such as the inhomogeneous properties of soil, are discussed. The migration of nuclides over the soil profile is reviewed with regard to type of soil, climatic zones, isotope composition of nuclides, conditions of their deposition on soil surface, and migration time. The fixation of nuclides, particularly Cs 137, by clay minerals is discussed. Root nutrition of

<1013> CONT.

plants is discussed with emphasis on absorption of Sr 90 and Cs 137 and other radionuclides. (NSA)

<1014>

Prokhorov, V.M., and A.S. Frid, Influence of Humus of the Diffusion Rate of Strontium 90 in Quartz Sand. 1966. Soviet Soil Science, 3, 303-305 (Scientific Research Institute of Agricultural Physics, USSR)

The coefficient of diffusion of strontium 90 in moist, finely ground quartz sand was strongly changed by addition of humic acids to the sand. Addition of 2 percent humic acids to pure sand reduced the diffusion coefficient 10 times. The diffusion rate of strontium 90 with the same content of humus and the same moisture content was higher in natural soils than in the quartz sand with added humic acids in the study. The principal reason for this is evidently to be found in the differing composition of the humus in the two cases. (Auth)

<1015>

Prokhorov, V.M., and A.S. Frid, Effect of Salt Concentration of the Soil Solution on the Diffusion Rate of Microamounts of Strontium in Soil. 1965. Soviet Radiochemistry, 7, 496-498

It has been shown experimentally that the diffusion coefficient of Sr 90 in moist soil depends strongly on the degree of salinity of the soil. With an increase in the equilibrium concentration of Ca (II) in the soil solution from $4 \cdot 10^{-3}$ to 0.58 N, the diffusion coefficient increases by a factor of 13. With a further increase in the concentration to 6.6 N the diffusion coefficient remains constant and equals approximately $10 \cdot 10^{-6}$ cm²/sec, which is of the same order as the diffusion coefficient of Sr 90 in moist quartz sand. (Auth)

<1016>

Prokhorov, V.M., and A.S. Frid, Effect of Humus Content and Composition on Strontium 90 Mobility in Soil. 1972. Soviet Soil Science, 4, 333-340 (All-Union Institute of Agricultural Physics, Moscow, USSR)

Actual diffusivity (D) can be used as a measure of the mobility of an element in soil. An increase in the content of humic substances was found to reduce the D of strontium 90 may differ more than 70 times, depending on the composition and content of humic substances. (Auth)

<1017>

Prokhorov, V.M., A.S. Frid, and E.V. Ryzhinskii, The Effect of Salts on Strontium 90 Adsorption by Soils. 1968. A-AC-82/G/L-1305; 13 p. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

Different kinds of soil (chernozem, podzolic, etc.) were ground and sieved, and then contacted with a Sr 90 solution or with distilled water to give the soil a moisture content of 42 wt%. The soil was allowed to contact the tracer solution for 40 to 54 days in order to attain equilibrium. The soil was separated from the solution by centrifugation, and allowed to stand for two weeks before counting in order to attain equilibrium between Sr 90 and its daughter Y 90. Salt solutions of HgCl₂-Hg₂SO₄, NaCl-Na₂SO₄, Hg(NO₃)₂, and EDTA were used at various

concentrations. High salt concentrations tended to displace Sr 90 from the soil. However in the presence of sulfate, Sr 90 could be carried down by insoluble alkaline earth precipitates to give anomalous results. EDTA tends to complex Sr 90 from the soil, especially if the soil is wet with water and not with a concentrated salt solution. An electrophoretic experiment showed that the Sr was in the form of positive ions. (NSA)

<1018>

Prokhorov, V.M., A.S. Frid, and M.V. Ryzhinskii, Effect of Liming of Soil on the Diffusion Rate of Strontium 90. 1970. Agrokimiya, 7, 40-48 (Agrophysics Institute, Leningrad, USSR)

Samples of soil from the Leningrad area were acidified with HCl, washed with distilled water, and treated with various ratios of CaO. It was found that with amounts of CaO up to 80 percent of the hydrolytic acidity the coefficient of diffusion of Strontium 90 decreased by a factor of 5. For CaO doses greater than 90 percent of the hydrolytic acidity the Sr 90 coefficient increased. (tr-Auth)

<1019>

Prokhorov, V.M., and R.Ya. Krashnoshchekova, Migration of Radioactive Strontium in Soil Under the Action of an Electric Field. 1965. Soviet Radiochemistry, 7, 463-468

A method of examining the simultaneous electromigration of ions and electroosmosis in a disperse, adsorbing medium is proposed and a differential equation describing this process is derived. Laboratory experiments were carried out to study the possibility of removing radioactive strontium contamination from soil using an electric field. It was shown that this purification is possible although it is a slow process. (Auth)

<1020>

Prokhorov, V.M., M.V. Ryzhinskii, B.M. Aleksakhin, and V.F. Goltzev, Prediction of Strontium 90 Vertical Migration in Soils by Using a Mathematical Model. 1974. Pochvovedenie, 1, 52-60 (Not given)

The calculation of Sr 90 distribution in five different soil profiles was made using a method designed by the authors. The diffusion coefficients of Sr 90 and the linear rates of its transfer by soil moisture in each soil layer served as parameters determining the rate of migration. (Auth)

<1021>

Prokhorov, V.M., and M.G. Safronova, Kinetics of the Self Purification of a Body of Water Containing Strontium 90 as a Result of Absorption of the Radionuclide by the Bottom Deposits. 1973. Ecology (USSR), 4, 101-105 (Not given)

The previously proposed diffusion model of the self-purification of natural water as a result of the absorption of Sr 90 by the bottom deposits agrees with the experimental data on the kinetics of the change in the concentration of Sr 90 in the water of the experimental lake. Together with the diffusion mechanism of self-purification, there operates additionally in the investigated lake a factor of self-purification that can be considered within the framework of the model. Simple computational formulas for the dependence of the concentration of Sr 90 in the water on the

<1021> CONT.

time were obtained, permitting a long-range prognosis for the experimental lake. (Auth)

<1022>

Prokhorov, V.M., and C. Tien-Ying, Diffusion of Cesium 137 into the Soil. 1963. Soviet Radiochemistry, 5, 598-600

The distribution coefficient of Cs 137 in moist soil is 20-250 times as great as the distribution of Sr 90 under the same conditions. The measured rate of diffusion of Cs 137 in light clayey soil proved to be anomalously high and during a substantial interval of moisture was practically equal to the rate of diffusion of Sr 90. The fraction of participation of adsorbed Cs (I) ions in the general diffusion flux, calculated on the basis of the hypothesis of two mechanisms of diffusion, comprises 95 percent. The mobility of these ions is equal to 0.002-0.003 of the mobility of Cs (I) in the free solution. (Auth)

<1023>

Prout, W.E., Adsorption of Radioactive Wastes by Savannah River Plant Soil. 1958. Soil Science, 86, 13-17 (Savannah River Laboratory, Aiken, SC)

The parameters affecting the adsorption of radioactive strontium, cesium, and plutonium in low-level waste solutions to soils were investigated. Maximum adsorption of strontium to soil was found at pH values between 5 and 9. (CWF)

<1024>

Purtyman, W.D., Plutonium in Stream Channel Alluvium in the Los Alamos Area, New Mexico. 1970, November. LA-4561; 7 p. (Los Alamos Scientific Laboratory, Los Alamos, NM)

A survey of plutonium isotopes Pu 238 and Pu 239 in the alluvium of major canyons in the Los Alamos Area was made to determine concentrations and movement of soil-bound plutonium. Trace concentrations of plutonium were found in alluvium in those canyons which have received or are receiving treated effluents from operations of the laboratory. The concentrations of plutonium in the alluvium of the remainder of the canyons were no greater than those concentrations attributed to world-wide fallout from atmospheric tests. (Auth)

<1025>

Rabinowitz, D.D., C.R. Holmes, and G.W. Gross, Forced Exchange of Tritiated Water with Clays. 1971. CONF-710809; Part of Moghissi, A.A. and Carter, M.W. (Eds.), Proceedings of a Symposium on Tritium held in Las Vegas, Nevada, August 30-September 1, 1971, (p. 471-485), 807 p. (New Mexico Institute of Mining and Technology, Socorro, NM)

Processes controlling fraction or fixation of tritiated water on clay minerals are discussed. Experimental electrodialysis data revealed preferential affinity of clay for tritiated water molecules. Total recovery of HTO from kaolinite could only be accomplished by heating 12 hr to 200 degrees C and acid washing. (CWF)

<1026>

Radicheva, M.A., and I.T. Mishev, Study of the Deposition of Radioactive Fallout in Certain Places in Bulgaria. 1966. Izv. Fiz. Inst. Aneb,

Bulg. Akad. Nauk, 15, 5-10

A number of investigations into the present activity of vegetation, soil, and water samples taken from various places in Bulgaria are described. In general, an increase in altitude over the sea level, results in an increase in the quantity of the fallout which has reached the soil and the plants on it, and the higher places are more abundantly covered with radioactive fallout. It was established that the active component of fallout is rapidly reduced after nuclear tests are discontinued. (tr-Auth)

<1027>

Radovanovic, R., R. Brnovic, Lj. Moracic, D. Panov, M. Vukotic, and D. Hajdukovic, Natural Activity and Fission-Product Contamination of the Environment and of the Food Chain on Serbian Territory from 1961 to 1968. 1970. CONF-690918-(Vol. 2); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 1065-1023), 684 p. (Institute of Occupational Health and Radiological Protection, Belgrade, Yugoslavia)

The results of radioactivity measurements on drinking water, food and bone are given; the concentrations of Pb 210, uranium and Ra 226 were determined on the same samples. The results of measurements of the natural gamma radiation doses in Serbian territory are also given. Significant differences were found to exist between the internal contaminations of the inhabitants of different regions. Since 1961 many samples of the environment have been collected on the territory of Serbia for the purpose of studying the passage of Cs 137 and Sr 90 through a large part of the food chain. During the period between 1962 and 1968, activities of 43 mCi/km² Sr 90 and 72 mCi/km² Cs 137 were deposited in Serbia by atmospheric fallout. From measurements of the Sr 90 and Cs 137 concentration in samples of soil, plants, milk, meat and bones, the transfer coefficients characteristic of the biological chain on Serbian territory were calculated. Cs 137 is measured by gamma spectrometry. Sr 90 is determined by oxalic precipitations of alkaline earths. The Y 90 activity is measured by the use of Al(OH)₃ as carrier for Y 90(OH)₃. (Auth)

<1028>

Rahola, T., and J.K. Miettinen, Cesium 137 in Man, Animals, and Plants in Lapland and in Southern Finland. 1969. NYO-3446-11; CONF-671062-2; Part of Proceedings of the Fourth Symposium on Radioactivity in Scandinavia held in Oslo, Norway, October 19-20, 1967, (p. 23-34) (University of Helsinki, Department of Radiochemistry, Helsinki, Finland)

The Cs 137 content of 47 Lapps residing in northern Finland was measured by whole-body counting in 1966 and again in 1967. An average decrease of 27.1 percent was noted. The sharp decrease in Cs 137 content was attributed to a change in the eating habits of reindeer caused by the devastation of hill birch forests by an insect and the substitution of wood hair grass for birch leaves and lichens in the diet of reindeers in the area. Data are included on the content of Cs 137 in meat from reindeer, in tissues of wolf and wolverine, and in lichens and higher plants sampled during 1966 and 1967. (NSA)

<1029>

Raikov, L., Natural Radioactivity of Bulgarian

<1029> CONT.

Soils. 1965. Rast. Nauki, 2, 31-36 (Soil Research Institute, Sofia, Bulgaria)

Total Beta-radioactivity of various soil types and paternal rocks was measured by means of STS-6 counter. Measurements were made with two cylinders, an outside and inside one. A tritiated soil sample of 150 g, shifted through an 1 mm mesh sieve, was put in the outside cylinder and in the inside cylinder, the wall of which is a thin paper, and placed in the cylindrical counter. Radioactivity of various soils is expressed in impulses per minute and it varies greatly. Cinnamon forest soils, developed over calcareous rocks, have a radioactivity of about ten impulses per minute, while the radioactivity of brown forest soils, underlain with rhyolites and alluvial and diluvial soils developed over materials originating in acid eruptive rocks attains ten times higher values. Chernozem soils, grey forest, chernozem-smolnitsa and podzolic cinnamon soils take a medium position within the extremes pointed out. The radioactivity of nearly all soils investigated was due (in two thirds of the cases) to radioactive potassium. Uranium, thorium and other element groups have a greater participation in the peat-bog and solonchak soils in the region of Plovdiv. Considerably increased radioactivity (2 to 3 times) of the 0 to 6 cm top soil layer was observed in virgin soils of certain mountain areas due to radioactive elements deposited by precipitation. (Auth)

<1030>

Rafa, M.E., and K.L. Babcock, On the Soil Chemistry of Radioiodine. 1961. Soil Science, 91, 1-5 (University of California, Berkeley, CA)

The behavior of carrier-free I-131 in two Californian soils, in two clay minerals, and in peat has been studied. The results of pretreatment by autoclaving, oxidation with peroxide and digestion with alcohol, as well as extraction of I 131 with various salt solutions, all indicate that the large fraction of I 131 retained by the soils is due to reaction with organic matter. (Auth)

<1031>

Ralls, J.W., H.J. Maagdenberg, T.R. Guckeen, and W.A. Mercer, Removal of Radioactive Strontium and Cesium from Certain Vegetables and Fruits During Normal Preparation for Preservation. 1969. Isotop. Radiat. Technol., 6, 149-153 (U.S. Department of Agriculture, Agricultural Research Service, Western Utilization Research and Development Division, Bethesda, MD; National Canners Association; Western Research Laboratory, Berkeley, CA)

Spinach, peas, and broccoli were sprayed with a sufficient amount of very dilute solutions of Sr 89 or Cs 134, to provide approximately 1 uCi per crop container. Dwarf pear and peach trees were sprayed with slightly stronger solutions to give 4 to 6 uCi per tree. Both fruits and vegetables were grown in soil treated with 15 uCi of radionuclide for each 40 lb of soil. External contamination was readily washed from fruits and vegetables picked 1 or 2 hr after treatment. Internal contamination could be reduced greatly by ordinary food-preparation processes, except for strawberries. (Auth)

<1032>

Ralls, J.W., S. Primbsch, T.R. Guckeen, H.J. Maagdenberg, J. Rinehart, F.C. Lamb, and W.A.

Mercer, Strontium and Calcium Distribution in Major Vegetable and Fruit Crops and Criteria for Use of Fallout-Contaminated Foods. 1967. Radiological Health Data and Reports, 8, 355-358 (National Canners Association, Berkeley, CA)

Vegetable and fruit crops were grown in soil enriched with high levels of strontium nitrate. The normally edible portions of the crops were harvested and sectioned into anatomically distinct portions. The strontium and calcium content was measured by flame spectrophotometry or by photon activation analysis. The results are tabulated to provide an upper limit for radiostromium content of crops grown in soil heavily contaminated with debris from nuclear fission on a massive scale. (Auth)

<1033>

Rana, S.K., and G.J. Ouellett, Correlation Between Plant Uptake and Different Methods of Extraction of Soil Cobalt. 1968. J. Indian Soc. Soil Sci., 16, 89-91 (Laval University, Department of Soils, Quebec, Canada)

Nine major soil series of Quebec Province in Canada were used to study extractability of soil cobalt with different extractants and their correlation with plant uptake under limed and unlimed conditions. Cobalt extracted with 2.5 percent acetic acid (pH 2.5) was highly correlated with plant content. The 1N NH4OAc and 0.01N HCl acid extraction did not show any such relationship with plant availability. (Auth)

<1034>

Rancon, D., Study and Demarcation of Pollution in Nonsaturated Soils. 1971. ST/PUR-268; CONF-701023; Part of Proceedings of a Symposium on the Use of Nuclear Techniques in the Measurement and Control of Environmental Pollution held in Salzburg, Austria, October 26-30, 1970, (p. 551-563) (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Cadarache, France)

A method was developed for evaluating the intensity and determining the extent of pollution in nonsaturated soils and for following its progress, with a view to preventing the pollution of aquifers in particular. A simple device is described which can be rapidly inserted to a depth of 3 to 4 m in loose soils. A neutron moisture gauge is introduced into borehole tubes in order to measure variations in the moisture content of the ground and thereby give warning of any movement of pollutants associated with water movement. A focalized probe specially designed for the purpose is then inserted into the same tubes and measures movement of the activity front of radioactive tracers or of various radioactive pollutants. The greater the number of access tubes the more accurate is the demarcation of the polluted zone. Numerous experimental releases of radioactive liquids have been carried out to test this device, the liquids being labeled with Sr 85 to simulate those elements retained by minerals and with I 131 to simulate those hardly retained. It was thus possible to measure the relative velocities of the activity and moisture fronts, determine the boundaries of the polluted zone and evaluate the volume of soil polluted. A study has also been made of the behavior of already polluted soil when it is traversed by noncontaminated seepage waters discharged at the surface, the risks of spreading and the possibility of confinement of the pollutants being assessed. The method is ready for use in the field.

<1034> CONT.
(Auth)

million) Co. The elements increase with increase in silt and clay contents of the soils. (Soils and Fertilizers)

<1035>

Rancon, D., Practical Utilization of the Distribution Coefficient for the Measurement of the Radioactive Contamination of Minerals in Rocks, Soil and Subterranean Water. 1972. CEA-R-4274; ANL-trans-931; 33 p. (Argonne National Laboratory, Argonne, IL)

The distribution coefficient, K_d , is of interest in studies of radionuclide retention by minerals and rocks. The measurements are quite simple to realize although certain precautions are indispensable in order to obtain representative values for natural media. It is particularly important to make a clear distinction between loose and consolidated rocks, to ascertain that the sample is representative and to determine the chemical nature of the solution in relation with the material. The studies made to date primarily dealt with long-lived fission products (Cs 137 and Sr 90), but other hazardous radionuclides, such as plutonium, would merit deeper research. The object of this report was not to study ground contamination by different radionuclides as such but to establish the most realistic way of considering these measurements so as to realize hazards of different subterranean media. (Auth)

<1036>

Rancon, D., Soil Contamination. Part 1. Changes in the Humidity of Unsaturated Soils after Reflect in a Limited Space. 1969, February. CEA-R-3635(1); 52 p. (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Cadarache, France)

An important feature in radiological safety studies of sites is the knowledge of water movements in the unsaturated layer surmounting the aquifer. This zone of aerated soil can be effective as a protection against aquifer contamination. Utilizing a neutron moisture meter, a method was developed to present graphically the water content of soil and the moistened volume evolution with time in the case of a limited infiltration surface. It is also possible to measure moisture gradients, drying kinetics, the retention capacity of soil, and the water content achieved by a given water head. The initial aqueous state effects the infiltration rate and not the moistened front position or the volume of moistened soil; consequently, the amount of storable water in the soil can be calculated. When water infiltration was stopped, the volume of moistened soil increased to an equilibrium state restricted by the moistened front and all the other water movements occurred exclusively inside this volume. In case of radioactive waste disposal, the ionic pollution will be confined inside a measurable volume, the moistened front being the maximum limits of this volume. (Auth)

<1037>

Randhawa, N.S., and J.S. Kanwar, Zinc, Copper, and Cobalt Status of Punjab Soils. 1964. Soil Science, 98, 403-407 (Punjab Agric. University, Ludhiana, India)

Contents in 7 profiles representing all climatic regions from moist to arid vary from 18 to 97.5 parts per million (average 54.5 parts per million) Zn, 6.6 to 36.4 (average 22.1 parts per million) Cu, and 4.4 to 32.5 parts per million (average 20.2 parts per

<1038>

Rasmussen, D.C., L.B. Smith, R.A. Kleese, and R.H. Rust, Genetic Control of Physiological Processes in Higher Plants, Technical Progress Report, 1965 - 1967. 1967, June. COO-1097-24; 65p. (University of Minnesota, Minneapolis, MN)

Progress is reported on studies on the inheritance of the capacity for Calcium 45 and Strontium 89 accumulation in grain of barley and wheat. Data are included from studies on the uptake of Strontium 89 in various plant parts of normal and grafted soybeans, and genetic, metabolic, and physiological factors that influence the uptake of Strontium 89 and nutrients from soil. The effects of soil properties, especially nutrient content, on the uptake of Strontium 89 by barley and wheat from soils were also studied. Data are included from preliminary studies on the effects of the essential mineral elements, P, K, Ca, Na, Fe, Mg, Zn, Cu, Mo, Mn, and B on the uptake of Strontium 89 by plants. (NSA)

<1039>

Raymond, J.R., Cesium and Strontium Distribution Beneath Liquid Waste Disposal Sites. 1966. BNWL-235-3 (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Investigation was made of radiocontaminant concentrations and distribution beneath selected liquid waste disposal facilities. Additional wells were drilled and core samples taken of the earth materials for laboratory analysis. The bulk of the long-lived radioisotopes, such as cesium 137 and strontium 90, was found retained high in the soil column some 100 feet or more above the regional water table. Thus the effectiveness of the soil in removing certain radioisotopes by absorption and ion exchange is confirmed. (Auth)

<1040>

Rediske, J.H., J.F. Cline, and A.A. Selders, The Absorption of Fission Products by Plants. 1955, May 17. HW-36734; 17 p. (Hanford Atomic Products Operation, Richland, WA)

The absorption of the important fission products by plants is quantitatively presented as a concentration factor which is defined as the ratio of the fission product concentration found in the leaves to the fission product concentration found in the nutrient substrate. Of the fission products, the isotopes of strontium were found to be the most important by virtue of their high concentration factor, long half-life, and low maximum permissible amounts for animals. Iodine and barium follow in importance, with cesium moderately important in some soils. All other fission products have concentration factors less than strontium by 100 or more. The effect on the concentration factor of different agricultural plants, as well as different organs of the same plant, causes variations of about a factor of ten or less for each isotope. The concentration factor tends to increase as the pH of the nutrient substrate is decreased. Addition of stable carrier to the substrate does not decrease the amount of the radioactive isotope that is absorbed into the plant. The presence of iodine and yttrium carrier actually causes a significant increase in the concentration of the respective radioactive isotopes in the plant tissue.

<1040> CONT.
(Auth)

<1041>
Rediske, J.H., and A.A. Selders, The Absorption and Translocation of Strontium by Plants. 1953. Plant Physiology, 28, 594-605 (Hanford Atomic Products Operation, Radiological Sciences Department, Biology Section, Richland, WA)

There was found to be no significant redistribution of strontium within the leaf system of the bean plant grown at a pH of 6.0 even though favorable concentration gradients existed. It was shown that the absorption of strontium is proportional to the concentration in the nutrient solution up to 100 ppm. This indicates that there is no deleterious effect of strontium concentration on the uptake mechanism below 100 p.p.m. The accumulation of strontium on the root decreases as the acidity is increased between pH 7.0 and 4.0. The ratio of leaf strontium concentration to root strontium concentration increases linearly as the pH decreases. (Auth)

<1042>
Rehak, W., and B. Feddersen, Radiochemical Determination of Cesium 137 in Soil. SZS-1/76; (p. 8-18) (Staatliche Zentrale fuer Strahlenschutz, Berlin, German Democratic Republic)

A radiochemical method for the determination of Cs 137 in soils is described. The method is characterized by the decomposition of the soil by NaOH, the separation of Cs 137 and carrier cesium by a batch extraction with ammonium molybdophosphate, and measurement of the beta activity of the Cs2PtCl6 precipitation. The efficiency of various methods of decomposition of the soil is compared. (Auth)

<1043>
Rehak, W., and G. Uhl, Radiochemical Determination of Cerium 144 and Cerium 141 in Environmental Samples. 1970. SZS-1/70; p. 19-30 (Staatliche Zentrale fuer Strahlenschutz, Berlin, German Democratic Republic)

An analytical method is described for determination of Ce 144 and Ce 141 in environmental samples. The method is based on the extraction by bis(2-ethylhexyl) phosphate. (Auth)

<1044>
Reichenbach, H., and G. Bussche, Investigations on the Sorption of Strontium in Schleswig-Holstein Soils. 1963, April. Z. Pflanzenernaehr. Dueng. Bodenk., 101, 24-33 (Christian-Albrechts-Universität, Kiel, German Federal Republic)

The distribution of small additions of Sr, as Strontium 90, in water-soluble exchangeable, and nonexchangeable forms was investigated in 165 samples of Schleswig-Holstein soils and its relation to soil properties such as exchange capacity, pH value, and clay and carbon content was determined using multiple regressions. Under the conditions in soil used, the water-soluble fraction of the added Strontium was small. Strontium was thus retained in the top few cm of the soil, almost independently of the soil properties. The displacing action of percolation, caused by precipitation, was therefore small. Part of the Sr was transformed into the nonexchangeable form. The amount of the

nonexchangeable fraction was dependent on soil properties, especially on the nature of the exchange features in the soil. With increasing carbon and humus content and exchange capacity, the non-exchangeable fraction of Sr increased. With decreasing clay content and pH value, it increased to a smaller extent. The significance of these results is discussed with regard to Sr available to plants. (NSA)

<1045>
Reichert, S.O., Some Geological Aspects of Radioactive Waste Management. 1967. CONF-680202-4; DP-MS-78-108; Part of Proceedings of the Annual Meeting of the American Institute of Mining Metallurgical and Petroleum Engineers held in New York City, February 25-29, 1968, 28p. (Savannah River Laboratory, Aiken, SC)

At nuclear facilities, three types of radioactive waste must be managed: (1) high-level liquid waste containing fission products from the chemical separation of irradiated uranium, (2) low-level condensates from the concentration of the high-level waste, and (3) dry solids such as obsolete process equipment, spent ion exchange resins, and irradiated metal scrap. The geological and environmental characteristics of a site are important considerations in planning the waste management program. At the Savannah River Plant, low-level liquids and dry solids are safely and economically placed in the soil where the geologic and hydrologic conditions are favorable. Within the general area where the waste originates, studies are made to locate seepage basins and burial grounds in the most favorable sites: (1) soils should have a high ion exchange capacity and moderate to low permeability, (2) the water table should be deep, and (3) burial sites should be relatively distant from the nearest flowing stream. (Auth)

<1046>
Reiniger, P., M.J. Frissel, and P. Poelstra, Calculation by Digital Computer of the Migration Rate of Strontium 90 in the Soil. 1970. CONF-690918-(Vol. 1); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 589-609), 684 p. (Euratom-Ital, Wageningen, Netherlands)

A mathematical model of strontium 90 transport in the soil is presented. The total transport rate is calculated by addition of the component rates, these being the rates of chromatographic transport, biological transport, and displacement by ploughing. The climatological parameters used in these calculations may be time variables. The biological parameters and those of the soil may be variables of time, of position in the soil profile or of both. The mathematical model uses the CSMF (continuous system modeling program) for the IBM 360/50 digital computer. The results of calculations for an experimental field with three pH levels and for a muddy soil are compared to the strontium 90 values measured over a period of eight years. (Auth)

<1047>
Reisenauer, A.E., Laboratory Studies of Hanford Waste Cribbs. 1959. HW-631212; 15 p. (Hanford Atomic Products Operation, Richland, WA)

Laboratory research on the fixation and retention of radioactive materials on soils was undertaken for application to the ground

<1047> CONT.

disposal of low- and intermediate-level waste solutions from Hanford chemical separations plants. Tabulation of pertinent laboratory data on Hanford waste cribs is presented. The results of the research permit the estimation of waste volumes which would produce a limited breakthrough of long-lived nuclides into the ground water for a given crib and type of waste. (Auth)

<1048>

Reissig, H., Studies of the Strontium 90 Wash-Out in Soil. 1966. Chem. Erde, 25, 204-229 (Technische Hochschule, Dresden, German Democratic Republic)

The uptake, distribution, and migration of Sr 90, as reflected by literature sources are described. A mathematical model of Sr 90 washout constructed from results of lysimeter measurements made from 1959 to 1965 demonstrated good agreement with the migration of Sr 90 in soils of average or greater than average cation exchange capacity. Variations observed in soils with small cation exchange capacities were due probably to rapid flow through which limited the exchange effect of the Sr 90 ions with the soil sorption complex. There was a slight negative relation between the cation exchange capacities of the soils and the Sr 90 migration rates. The Sr 90 distribution in a contaminated study section, and the Sr 90 fallout in several vertical profiles from soil samples obtained in June 1964 from cropland, grassland, and desert land are discussed. In general, the studies all showed that in most soils the Sr 90 migration rate was less than 1 cm/700 mm of precipitate. Because of this it did not seem that any significant washout of Sr 90 from the upper soil layers would take place over time interval of 20 or 30 yr. (NSA)

<1049>

Reissig, H., Cesium 137 in Agriculturally Useful Plants and Soils in the Territory of the GDR (German Democratic Republic) 1960-1963. 1965. Albrecht-Thaer-Arch., 9, 555-572 (Technische University, Dresden, German Democratic Republic)

The Cesium 137 content was determined by gamma spectrometry in ash samples of various agricultural plants taken from the harvests of 1960 to 1963. The results showed that the Cesium 137 contents observed in the plants in 1962, and particularly in 1963, were substantially higher than those found in 1960 to 1961 which is in good agreement with the fallout conditions of those years. The Cesium 137 content of the soils concerned was determined by calculation (soil sampling in June or October 1963), on the basis of the Strontium 90 content of the soils as well as on the basis of the Cesium 137/Strontium 90 activity proportion in fallout. The relative share of Cesium 137 in surface contamination as well as in root adsorption for 1963 was also estimated by calculation on the basis of the Cesium 137 data for soils and plants and of the Strontium 90 data for surface contamination of plants. The results suggest a considerable level of Cesium 137 surface contamination on plants in 1963. (NSA)

<1050>

Reissig, H., Strontium 90 Contents of Soils and Plants from the Territory of the GDR in 1961. 1963. May. Kernenergie, 6, 231-238 (Technische Hochschule, Dresden, German Democratic Republic)

The investigations begun in 1960 on the Sr 90

content of soils and plants were continued in 1961. The cumulative Sr 90 content in soils had neither increased nor diminished compared to 1960. The occurring fluctuations lie for grass land and surface soil in the domain of the method and sampling errors. The Sr 90 contamination of various plants and plant harvest products likewise did not deviate essentially from the results obtained in 1960. The relation ascertained in 1960 between the soil and plant contaminations was confirmed in 1961. The Sr 90 contamination of the vegetation occurred chiefly by absorption through the root systems. The amount of surface contamination with Sr 90 in comparison with the total Sr 90 content in grass samples was evaluated for 1961 as an average of 27 percent. (tr-Auth)

<1051>

Reissig, H., The Estimation of the Strontium 90 Surface Contamination and Absorption of Strontium 90 into the Root by Agricultural Plants within the Range of Local Fallout from Nuclear Explosions. 1967. Wiss. Z. Tech. Univ. Dresden, 16, 243-248 (Technische University, Dresden, German Democratic Republic)

The surface contamination and root uptake of various agricultural crops by Sr 90 from local fallout after nuclear weapons explosions were evaluated on the basis of empirical assumptions and relations. Relations between the dose yield and surface activity or contamination density were estimated from particle fall velocity vectors, potentially soluble Sr 90 atom density, MC_1 of Sr 90/km², and radiation intensity. The Sr 90 surface contamination of plants from local fallout was estimated from the fallout retention of plants as a function of particle size, the average dwell time of fallout particles on plants, and empirical factors used for evaluation of Sr 90 surface contamination of plants including grass, red clover, rye, cabbage, turnip leaves, potato plants, and ensilage within the range of the radioactive track of a 1-Mt nuclear explosion, local fallout at fixed wind velocities, and downwind dosages at distances up to 500 km. The long-term uptake of Sr 90 from local fallout by plant roots was evaluated from these theoretical parameters and evidence from previous studies. (NSA)

<1052>

Reissig, H., The Maximum Permissible Contamination of the Soil with Strontium 90. 1961. Wiss. Z. Tech. Hochschule, Dresden, 10, 395-403 (Institut fuer Bodenkunde und Standortlehre, Dresden, German Democratic Republic)

Maximum permissible concentrations (MPC) of Strontium 90 were evaluated for several soil types. The values were based on the MPC of Strontium 90 for the human skeleton and on data for discrimination between Strontium and Calcium during passage from soil to man. Several factors that affect the Strontium 90 concentration of soil were discussed. These included relations of Strontium 90 in soil and the turnover of Strontium 90 and Calcium in soils, the passage of Strontium 90 from soils by way of plants and milk to the human skeleton, evaluation of MPC of Strontium 90 in soils, the effects of the retention of Strontium 90 on the plant leaf surfaces or cuticles on its MPC, proportionality factors for calculation of Strontium 90 contamination in plants and milk, and the possible effects of agronomical procedures on the MPC of Strontium 90. Generally, the decrease of activity in soil takes place primarily only by

<1052> CONT.

way of physical decay. Since the physical decay of Strontium 90 is slow compared to man's lifetime, other, additional measures would be required to reduce concentrations of Strontium 90 in soils, plants, or milk. This would require addition of K ions to soil, incorporation of Ca compounds in cattle fodder, or removal of Strontium 90 from milk by ion exchangers. (NSA)

<1053>

Reitemeier, R.F., Soil-Plant Relationships of Radioactive Nuclides in Fallout. CONF-671135; Part of Proceedings of a Symposium on Postattack Recovery from Nuclear War held in Fort Monroe, Virginia, November 6-9, 1967 (p. 143-148) (Atomic Energy Commission, Washington, DC)

The uptake of radioisotopes from soil by food crops in a long-term postattack period was considered. Only several fission products were considered to be sufficiently abundant and biologically available. Cesium 137 was considered the most abundant; Sr 90, second. Strontium 90 and its daughter Y 90 and Cs 137 - Ba 137 would account for most of the biologically available isotopes in the soil. Other fission products that would be present in great abundance were Ce 144-Pr 144, Ru 105-Rh 106, Pd 147 and Sb 125; this group of isotopes which is only slightly available to plants was not considered to be too important. A detailed discussion of Sr 90 and Cs 137 metabolism by plants is then presented. (NSA)

<1054>

Reitemeier, R.F., and R.G. Menzel, Relation of Radioactive Contamination of Crops to Soil Fertility. 1960. Part of the Proceedings of the Seventh International Congress of Soil Science held in Madison, Wisconsin, 1960, (p. 35-45) (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Beltsville, MD)

Nuclear fission installations and devices are possible sources of radioisotopes which may contaminate crops and soils. With respect to the longer-term food chain hazard, most attention has been directed to the fission products strontium 89, strontium 90, and cesium 137. The uptake of radio-strontium by plants generally varies opposite to the level of exchangeable calcium in the soil. Increasing the exchangeable calcium content of highly acid soils by adding lime often reduces substantially the radiostrontium content of plants or the ratio of radiostrontium to calcium. Applications of ammonium salts have increased the uptake of radiostrontium by oats, and the uptake of radiocesium by oats and rice. Additions of potassium, however, frequently decrease the uptake of radiocesium and radiostrontium. Large additions of decomposable organic matter have reduced the uptake of radio-strontium but also that of calcium. Application of potassium, calcium amendments, or organic matter at practical rates usually will not be of sufficient benefit to serve alone as an effective control measure. The maximum production of crops therefore should be the primary basis for the fertilization of contaminated soils. (Auth)

<1055>

Resnik, M.C., O.R. Lunt, and A. Wallace, Cesium, Potassium, Strontium, and Calcium Transport in Two Different Plant Species. 1969. Soil Science, 108, 64-73 (University of California, Los Angeles, CA)

Bush bean and barley plants were exposed to factorial combinations of potassium and calcium in which one or the other was labeled with K 42 or Ca 45. Other experiments were conducted with Cs 137 and Sr 85. Attempts were made to exclude from analysis those radioactive isotopes associated with the free space and cation-exchange sites in roots. Calcium accumulation in roots appeared to be independent of, but translocation to shoots was dependent upon temperature at 10 (E-3) and 10 (E-5) M calcium. Data at 10 (E-1) M were conclusive. Temperature dependency for calcium translocation to shoots decreased with increasing potassium. Potassium accumulation and translocation were temperature dependent particularly with the two low concentrations. The temperature dependency for potassium accumulation in bush bean roots increased with increasing calcium but the reverse occurred in both species for translocation to shoots. Cesium accumulation was temperature dependent for bush bean as was translocation for both species. Cesium translocation, however, did differ from that of potassium. At low temperature, calcium levels greatly inhibited potassium accumulation by roots in bush beans but to a much lesser extent in barley. The effect for cesium was almost absent in barley. Little effect was observed on translocation to shoots. This resulted in a large temperature-calcium level interaction on the proportion of potassium and cesium translocation to shoots in bush beans. Calcium translocation to tops increased with increasing calcium levels much more at 24 degrees than at 0 degrees Centigrade. Barley with a lower root cation-exchange capacity than bush bean tended to accumulate more potassium and cesium than bush bean particularly at the low temperature and at the highest calcium level. Bush bean tended to accumulate more calcium than barley and this in general was most pronounced at the lowest calcium level. (Auth)

<1056>

Reynolds, R.C., Jr., Cobalt Sorption on Surface Reactive Minerals in the Glacial Environment, Progress Report, February-December 1970. 1971. NYO-3912-3; 21 p. (Dartmouth College, Hanover, NH)

Progress is reported on a study of the distribution and compositions of natural waters in the South Cascade Glacier region, and on the regoliths and stream and lake sediments in this alpine environment. New analytical techniques were developed for the analysis of Ca + Mg, K, Na, Cl(-), and SO4(-2) by means of ion sensitive electrodes. Work was performed in the laboratory that provides data on the cobalt and cesium sorption characteristics of natural silts in natural waters. Finally, progress was made toward the development of a quantitative model for cobalt sorption on vermiculite in the presence of interfering ions. (Auth)

<1057>

Reynolds, R.C., Jr., Cobalt Sorption on Surface Reactive Minerals in the Glacial Environment, Three-Year Summary Report, August 1967 - February 1971. 1971. NYO-3912-4; 79 p. (Dartmouth College, Hanover, NH)

Progress is reported covering the three year period of August, 1967 to February, 1971 on a study of the cobalt sorption on surface reactive minerals in a glacial environment. Results reported are: cationic denudation in the South Cascade Glacier Region is presently occurring at rates that are approximately three times the world average; the dominant

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driving force for chemical weathering consists of continuous carbonation of surface waters during their transit of the watershed; dominant clay mineral in the area is vermiculite, and it forms by the alteration of biotite; clays are sufficiently abundant to provide high cation exchange capacities in local sediments; ion sensitive electrodes can be used for the analysis of Ca + Mg, K, Na, Cl (-1), and SO₄ (-2). Preliminary data on cobalt and cesium sorption and the development of a quantitative model for cobalt sorption on vermiculite are also presented. (NSA)

<1058>

Rhodes, D.W., Preliminary Studies of Plutonium Adsorption in Hanford Soil. 1952. HW-24548; 22p. (Douglas Aircraft Company, Tulsa, OK)

Some preliminary studies of the adsorption of Pu from aqueous solutions by soil indicate that at concentrations of <100,000 d/m/ml and a neutral or slightly acid pH, Pu is adsorbed very effectively (>99%). The greater portion of the Pu is adsorbed almost instantaneously and seems to be adsorbed just as effectively from a solution containing as much as 82 gm/l of salts as from distilled water. Plutonium is adsorbed most effectively by the soil constituents having a high specific surface and a high cation exchange capacity. The results in general indicate that an exchange reaction is probably the predominate mechanism involved in the removal of Pu from solution by soil. (Auth)

<1059>

Rhodes, D.W., The Effect of pH on the Uptake of Radioactive Isotopes from Solution by a Soil. 1957. Soil Science Society of America Proceedings, 21, 389-392 (General Electric Company, Richland, WA)

The reactions with natural earth materials of fission products and plutonium are of current interest in the field of atomic energy waste disposal and soil chemistry. Solutions containing less than nano moles per liter of selected radioisotopes were equilibrated with samples of a clacareous subsoil. The uptake of these radioactive isotopes by the soil was measured as a function of pH. The uptake of cesium 137 was not affected appreciably by varying the pH between 4 and 10. The maximum uptake of Sr 90 occurred at about 10 and decreased rapidly as the pH was lowered. The radioisotopes Pu 239, Ce 144, Zr 95, Y 91, and Ru 106 exhibited a maximum uptake between approximately pH 4 and pH 8. (Auth) (CHF)

<1060>

Bible, J.M., and L.E. Davis, Ion Exchange in Soil Columns. 1955. Soil Science, 79, 41-47 (University of California, Davis, CA)

A simple, general theory of ion exchange in soil columns is derived by an extension of DeVault's theory of chromatograms. The exchange isotherms required to apply this theory to ion exchange is derived from the statistical theory developed by the authors. Hypothetical conclusions derived from the theory can be most readily and briefly visualized by reference to the solid lines shown in the figures. Good agreement between theory and experimental results was obtained with Yolo fine sandy loam soil for the replacement of Ca by Mg and by Na. Fair agreement was obtained when Ca replaced Na but not when Ca replaced Mg. It is tentatively concluded that Na and Mg not only replace

considerable Ca, but also penetrate readily into the subsoil zone of a Ca soil. On the other hand, Ca in dilute solutions of calcium salts readily replaces most of the Na in a surface layer of Na infested soil but does not adequately penetrate to the subsoil. (Auth)

<1061>

Richter, D., On the Localization of Strontium 90 Fallout in Soils. 1965. Chem. Erde, 24, 67-76 (University of Jena, Jena, German Democratic Republic)

Five soils typical of central Germany, including black soil from loess, variegated sandstone, bottcaland, and shell lime were examined in 1961 for their Strontium 90 content at levels of 0 to 20 and 20 to 40 cm depth. In the upper layers, the average decay rate/200 g soil was 37 cps of Strontium 90. In the 20 to 40 cm level the average was 5 cps/200g of soil. These values were remeasured in 1963 and almost identical results were obtained for the soil at the 0 to 20 cm depth. These results indicate that there had been very little movement of Strontium 90 during the 2-year period, taking into account the fallout measurements that also had been made in this interval. Some of the physicochemical factors that may affect movement of Strontium 90 in soils are discussed. (NSA)

<1062>

Rickard, W.H., Cesium 137 in Litter and Understory Vegetation. 1966. Northwest Science, 401, 25-30 (Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA)

Cesium 137 derived from worldwide fallout was measured in the understory vegetation and leaf litter of three different mature conifer stands in the Cascade Mountains of Washington in September, 1964. The Cs 137 concentration of understory shrubs was more or less similar among the three stands. However, more Cs 137 was present in the understory in the hemlock (TSUGA HETEROPHYLLA) stand when expressed as Cs 137 per square meter of ground because of the more luxuriant understory growth in this habitat. Cesium 137 in leaf litter was most abundant in a fir (ABIES AMABILIS) stand near the mountain summit. The leaf litter of a hemlock stand in a high-precipitation region west of the mountains had higher Cs 137 concentrations than did the litter from a ponderosa pine (PINUS PONDEROSA) stand from a lower-precipitation region east of the mountains. (Auth)

<1063>

Rickard, W.H., Accumulation of Cesium 137 in Litter and Understory Plants of Forest Stands from Various Climatic Zones of Washington. 1966. BNWL-SA-530; CONF-660405; Part of Aberg, B. and Hunkate, F.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, 1051 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA)

Estimates of the entire amount of Cs 137 present in Pacific Northwest conifer forest stands are difficult to obtain because of the difficulties of obtaining samples from tall trees. However, a sampling of forest floor plants and litter indicates that gross differences in Cs 137 accumulations can occur in forest habitats characteristic of

<1063> CONT.

contrasting climatic zones of the same latitude. Cesium 137 tends to accumulate in carpets of forest moss or in litter. There is little movement of Cs 137 into the mineral soil of the forest floor. (Auth)

<1064>

Rickard, W.H., Radiocesium Fallout in the Forest Floor. 1971, March. J. Forest., 69(3), 158-160 (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Cesium 137 derived from fallout persists in small but measureable amounts in the litter and mosses on the floor of conifer stands in the Cascade Mountains of Washington. Little change in the total amount of radiocesium was observed during the year 1967, 1968, and 1969. More radiocesium was present per unit area of forest floor in four stands located in a high rainfall region west of the Cascade Crest than in a single stand located east of the crest in a low rainfall region. (Auth)

<1065>

Rickard, W.H., Cesium 137 in Cascade Mountain Vegetation - 1966. 1969. CONF-670503; Part of Nelson, D.J. and Evans, F.C. (Eds.), Proceedings of the Second National Symposium on Radioecology held in Ann Arbor, Michigan, May 15-17, 1967, (p. 556-560), 774p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Environmental and Radiological Sciences Department, Richland, WA)

The leaf litter collected from the floor of stands representative of the coniferous forest east and west of the Cascade Mountains of Washington State was analyzed for fallout radionuclides. The litter from stands located in a high rainfall area west of the mountain summits had higher concentrations of Cs 137 (pCi/g) than did the litter from stands located in a lower rainfall area east of the summit. Emergent sedges growing in water several decimeters deep accumulated three times more Cs 137 than did the same kind of sedges growing nearby but not in standing water. (Auth)

<1066>

Rickard, W.H., and L.L. Eberhardt, Fallout Radiocesium in Sedges and Trout of a Cascade Mountain Bog. 1971. BNWL-SA-3878; CONF-710501-1; Part of Nelson, D.J. (Ed.), Proceedings of the Third National Symposium on Radioecology held in Oak Ridge, Tennessee, May 10-12, 1971, (p. 349-353), 1268 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

Radiocesium from worldwide fallout was measured in the sedges and in the eviscerated bodies of cutthroat trout collected from a Cascade Mountain (Washington) bog during the years 1967, 1968, 1969, and 1970. The bog is poor in essential mineral nutrients and located in a high rainfall area. These environmental features enhance the incorporation of radiocesium into the mineral cycling of bog biota. The early spring harvests of sedges generally had the highest concentration of radiocesium and the autumn harvest the smallest amounts. Radiocesium values in sedge ranged between 5 and 30 pCi per gram dry weight. The peak harvest yield of sedge mat vegetation amounted to 210 g/m² in 1968 and 1969. The Cs 137 concentration of eviscerated trout ranged from less than 1 pCi/g dry weight to 5 picocuries. In general the larger sized fish had higher burdens of Cs 137 than smaller sized fish. (Auth)

<1067>

Rik, R.G., O.B. Petrova, L.H. Misyuk, and L.V. Plantonova, Search for a Shift in the Isotope Composition of the Elements Strontium, Rubidium, Calcium, Potassium, and Lithium when Absorbed by Plants from Nutrient Medium. 1961. Biofizika, 6, 740-744

A table of the distribution of the isotopes of strontium, rubidium, calcium, potassium and lithium in the environment is given. In this experiment the error in measuring the isotopic composition of an element was plus or minus 1 percent. The data shows, that, with the given accuracy, there is no shift in the isotopic composition of the elements when plants are absorbing them from the surrounding medium. Thus, there is no evidence at this time that plants selectively absorb one isotope of an element over another from the environment. (Auth) (SST)

<1068>

Rincoet, A., and D. De Zeeuw, Discrimination between Calcium and Strontium in Oat Plants. I. Influence of the Growth Stage of the Plants and of the Osmotic Potential of the Root Medium. 1968. Z. Pflanzenphysiol., 59, 238-248 (Euratom-Ital, Wageningen, Netherlands)

Calcium and Strontium 85 uptake, transport and distribution, for varying osmotic values (mannitol concentrations) of the root medium, was studied in young and flowering oat plants (Avena sativa L., Cv. Marne). Uptake in the low osmotic treatments (0.5 to 5 or 7.5 atmospheres) is not reduced. A marked inhibition of uptake is observed at higher osmotic values (7.5 to 12.5 atmospheres). The rate of uptake also varies with the osmotic value of the external solution. The uptake and transport for both elements seem to be consistent with a mechanism conditioned by exchange reactions in the conducting tissue. The exchange sites may also be the sites of discrimination. Discrimination against strontium exists in the various aerial parts of young plants and to a smaller extent also in flowering plants. Discrimination always increases at high osmotic value of the external solution. It is suggested that discrimination in the high osmotic value of the external solution. It is suggested that discrimination in the high osmotic treatments is not conditioned by the transpiration water flow but results from a relatively smaller root uptake of strontium, which is due to its selective retention in the apparent free space of the roots or to its differential leakage from the root into the root medium. (Auth)

<1069>

Ritchie, J.C., E.E.C. Clebsch, and W.K. Rudolph, Distribution of Fallout and Natural Gamma Radionuclides in Litter, Humus and Surface Mineral Soil Layers Under Natural Vegetation in the Great Smoky Mountains, North Carolina-Tennessee. 1970. Health Physics, 18, 479-489 (University of Georgia, Department of Botany, Athens, GA; University of Tennessee, Department of Botany, Knoxville, TN; Ridgecrest School, Albemarle, NC)

The bulk density, pH, and weight of unincorporated organic matter were determined in soils at four sites of contrasting exposure and vegetation cover at different elevations. Total Cs 137, Ru 106, Ce 144, and K 40 in the organic matter and first 11.4 cm of mineral soil were determined by gamma spectrometry from samples taken in early September, 1961.

<1069> CONT.

Totals of these fallout nuclides ranged from 95.6 to 144.5, 81 to 137, and 88 to near 418 uCi/m², respectively. The pattern of distribution of nuclides is related to precipitation, vegetation cover, and layer in the soil, with Cs 137 showing the most consistent pattern. (Auth)

<1070>

Ritchie, J.C., J.R. McHenry, and A.C. Gill, The Distribution of Cesium 137 in the Litter and Upper Ten Centimeters of Soil Under Different Cover Types in Northern Mississippi. 1972. Health Physics, 22, 197-198 (U.S. Department of Agriculture, Sedimentation Laboratory, Oxford, MS)

The distribution of fallout cesium 137 was considerably higher in the top 2 cm of forested soil than grass soil. Analyses to the depth of 10 cm at an eroded site revealed less than 5 percent of the total activity present at the forested or grass covered sites. (CNF)

<1071>

Ritchie, J.C., J.R. McHenry, A.C. Gill, and P.H. Hawks, Fallout Cesium 137 in Reservoir Sediment. 1972. Anal. Chem., 28, 216-218 (U.S. Department of Agriculture, Sedimentation Laboratory, Oxford, MS)

Distribution of cesium 137 in the sediment profiles from various reservoirs reflect the quantity and time of sedimentation. (CNF)

<1072>

Ritchie, J.C., J.R. McHenry, and A.C. Gill, Distribution of Cesium 137 in the Litter and Upper 10 Centimeters of Soil under Different Cover Types in Northern Mississippi. 1972. Advances in Chemistry Series No. 93; Part of Freiling, E.C.(Chm.), Proceedings of a Symposium on Radionuclides in the Environment held in San Francisco, California, April 1, 1968, (p. 118-137) (U.S. Department of Agriculture, Sedimentation Laboratory, Oxford, MS)

Three each of litter and soil samples were collected in 2.5 cm or 5.0 cm increments, to depths of 10 cm, from oak-hickory and pine woodland, pasture and eroded sites in northern Mississippi. Gamma ray spectra of the soil layers are presented. The concentration and redistribution of fallout Cs 137 appeared to be related to the vegetative cover and amount of erosion, the highest concentrations being found in the surface 2.5 cm soil layer under oak-hickory and the next highest in the surface 2.5 soil layer under pine and grass. The total Cs 137 concentration measured in the eroded sites was less than 4% of that measured at other sites. (NSA)

<1073>

Ritchie, J.C., and G.L. Plummer, Natural Gamma Radiation in Northeast and East-Central Georgia. 1969. September. Bull. Ga. Acad. Sci., 27, 173-194 (University of Georgia, Athens, GA)

Thorium, uranium and potassium (all naturally occurring), and beryllium 7, cesium 137, ruthenium 106, cerium 144, antimony 125, zirconium-niobium-95 and manganese 54 (all from fallout) were found in soil samples collected in northeastern and east-central Georgia. Thorium concentrations ranged from 3 to 70 ppm with an average concentration of 15.8 ppm. Uranium concentrations varied from 1 to 10 ppm with an average of 3.7 ppm. The average thorium to uranium ratio was 4.3:1.

Total potassium ranged from non-detectable levels to 4.8 percent with an average of 1.08 percent. Concentrations of thorium and uranium in granitic outcrop soils were the same as non-outcrop soils. Potassium concentrations in granitic outcrop soils were three times that of non-outcrop soils. Cesium 137 concentrations in outcrop soils were ten times greater than that in non-outcrop soils. Although concentrations given in this report cannot be considered as absolute values, they are good estimates of the thorium, uranium and potassium at the particular locations sampled and are probably representative of concentrations elsewhere in northeastern and east-central Georgia. Average concentrations of thorium and uranium were higher in the study area than those reportedly found in the worldwide lithosphere and soil. One probable cause for higher concentrations is the occurrence of monazite in the Georgia Piedmont. Commercially mineable uranium ores are usually at least 100 times more concentrated than any concentrations found in the study area. Neither uranium nor thorium is an active metabolite in plants or animals. Although uranium is more mobile than thorium in soils, neither uranium nor thorium concentrations are high in plant or animal tissues, therefore, they cannot be considered of great importance in ecological food chains. Potassium, on the other hand, is mobile in the soil, and is an active metabolite. Total gamma radiation (0-2.70 MeV) ranged from 560 to 8900 CPM/kq or a 18-fold range in activity. Calculated dose rates ranged from 2.25 to 38.30 uR/hr or a 17-fold range. The average dose rate for the 132 soils was 10.65 uR/hr. Distribution of thorium, uranium and potassium followed broad geologic patterns. Concentrations of these elements were lowest in the sandy materials of the Coastal Plain and highest in the basic igneous-metamorphic material of the Piedmont. Distribution of thorium, uranium and potassium in four soil series was best related to geologic parent material. The Piedmont soils, Appling, Madison and Cecil, had higher concentrations than sandy Norfolk soils of the Coastal Plain. A high correlation (r=0.88) was found between aerial gamma radioactivity and dose rates indicating that gamma aeroradioactivity maps can be used to delineate areas with different background radiation. (Auth)

<1074>

Ritchie, J.C., J.A. Spraberry, and J.R. McHenry, Estimating Soil Erosion from the Redistribution of Fallout Cs 137. 1974. Soil Science Society of America Proceedings, 38, 137-139 (University of Mississippi, Oxford, MS)

The movement of fallout Cs 137 from soils in three north Mississippi watersheds was found to be logarithmically (r = 0.89) related to potential soil loss as calculated by the Universal Soil Loss Equation. Analysis of other published data on Cs 137 as well as the north Mississippi data also showed a significant (r = 0.95) logarithmic relation existing between soil loss and Cs 137 loss from soils. This study indicates that it may be possible to calculate soil loss from the movement of fallout Cs 137 in watersheds. Also it may be possible to calculate the movement of surface adsorbed nutrients like Cs 137 in watersheds from soil erosion data. (Auth)

<1075>

Robbins, J.A., and D.N. Edgington, Determination of Recent Sedimentation Rates in Lake Michigan Using Lead 210 and Cesium 137. 1974. Geochim.

<1075> CONT.

Cosmochim. Acta (In manuscript) (University of Michigan, Great Lakes Research Division, Ann Arbor, MI: Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, IL)

This paper describes the first successful attempt to use Pb 210 and Cs 137 radioactivity measurements to determine the rates of sedimentation in the Great Lakes. Cores from eight locations in Lake Michigan were chosen for examination to cover as wide as possible a range of sedimentation rates and representative sedimentary environments. The surficial Pb 210 activity in the sediments varies between 7 and 23 pCi/gm dry wt and its profile in each core shows the expected exponential decrease with depth consistent with the assumption of uniform sedimentation rate over the last two centuries and secular equilibrium between supported Pb 210 and Ra 226 (0.5-1.0 pCi/gm dry wt). Companion measurements of Cs 137 indicate that the coring technique satisfactorily recovered the uppermost levels of the deposit and that the mobility of both radionuclides within the sediment while detectable, is small. Based on the limited number of cores analyzed to date, it appears that modern sedimentation rates are not very different from average rates for the last 7000 years. The excess Pb 210 appears to originate primarily from atmospheric fallout, but a further inventory of the Pb 210 distribution over the lake bottom must be made to properly assess the significance of other sources. The spatial concentrations of both Cs 137 and Pb 210 at certain stations suggest that the mode of transport of these radionuclides are comparable and involve attachment to settling particles. While diffusion appears to play a minor, if not negligible, role in the movement of both radionuclides within the sediments, post-depositional redistribution by physical mixing or biological processes can account for the limited mobility of both these radionuclides in several of the cores studied. (Auth)

<1076>

Roberts, H., Jr., and R.G. Menzel, Availability of Exchangeable and Nonexchangeable Strontium 90 to Plants. 1961. J. Agr. Food Chem., 9, 95-98 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Beltsville, MD)

Exchangeable and nonexchangeable fractions of strontium 90 were determined in soil samples taken from the plow layer of cultivated fields in the coastal plain of North Carolina in June 1955 and December 1958. Exchangeable strontium 90 contents averaged about 10 and 50 uCi per kg of soil on the two sampling dates, respectively. Nonexchangeable strontium 90 contents averaged 4 and 7 uCi, respectively. Lower amounts of both fractions of strontium 90 were recovered in samples extracted after dry storage for 1 year. The uptake of strontium 90 and calcium from these soils was studied by growing cowpeas in the greenhouse. From 8 to 18 percent of the exchangeable strontium was taken up, depending on the uptake of exchangeable calcium. Use of discrimination factors to determine availability of nonexchangeable strontium 90 to plants is discussed. Nonexchangeable strontium 90 apparently made little or no contribution to uptake. (Auth)

<1077>

Robinson, B.F., Ion-Exchange Minerals and

Disposal of Radioactive Wastes--A Survey of Literature. 1962. Geological Survey Water-Supply Paper 1616 (U.S. Department of the Interior, Washington, DC)

A relatively good survey of the types of minerals that might be used in disposal of radioactive wastes is described. It relates more closely to general clay chemistry than a review of experimental data involving the reactions of radionuclides with clay minerals. (CWF)

<1078>

Rodier, J., P. Niezborala, and M. Marichal, Comparative Study of the Behavior in Soil of Radioactive Waste Solidified by Various Processes. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 383-400) (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Marcoule, France)

The processing of radioactive waste has given rise to a certain number of intensive studies of industrial projects. Vitrification, encapsulation in bitumen and solidification in cement constitute three solutions to the problem of storing radioactive waste. A comparative study is made of the behavior of waste processed by these three methods in a specific soil and under particular atmospheric conditions. (Auth)

<1079>

Roessler, C.E., Cesium 137 and Other Gamma Radioactivity in the Florida Environment - A Study of Selected Media. 1967. Ph.D. Thesis; 181 p. (University of Florida, Gainesville, FL)

Kinds, levels, and distribution of gamma-emitting radionuclides in the Florida environment were investigated because of the unusual levels and characteristic geographical patterns of cesium 137 found in Florida milk and forage in earlier studies. Beef and vegetables were selected as the most important media for sampling in May and June, 1966, and during January through July, 1967. Analyses were performed by gamma spectroscopy on triturated whole samples and gamma spectra were interpreted in terms of the individual contributing components by use of the simultaneous equations method. The most significant gamma-emitting radionuclide present was Cs 137, and the evaluation of the data was concentrated on this nuclide. Levels of Cs 137 in both beef and vegetables showed geographical patterns of variation similar to those reported earlier by others in Florida milk. Maximum levels were found in the central and southern parts of the State, with intermediate levels in the northeastern and north central parts of the State, and the lowest levels in the northwestern part of the State. In addition, vegetable samples showed a marked difference from southeast to southwest, with average levels in the southeastern part of the State as low as in the northwestern part. Levels of Cs 137 in lower-quality meat from animals that had fed primarily on grass were much higher than those in high-quality meat from feed-lot animals. These levels were higher than any other levels reported in beef in the continental United States. There was no apparent difference in Cs 137 concentrations between leafy, fruit, and root categories of vegetables; although certain crops in each category did exhibit consistently higher levels than the other crops in the same category. Cesium 137

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<1079> CONT.

concentrations found in this study were compared to literature values, both to those reported for years previous to this study and to 1966 to 1967 values obtained by extrapolating published values to that time. The significance of the observed Cs 137 levels was evaluated in terms of the human intake of this nuclide. It was estimated that radioactivity intakes from locally produced food in Northwestern Florida would be similar to the national average. It was concluded that unusual environmental factors or mechanisms are involved in the levels of Cs 137 found in the Florida environment. The possibility of such mechanisms has important implications to waste disposal hazard evaluation, and nuclear facility operation. The mechanisms were not identified but here is increasing evidence that the role of uptake from the soil is greater than reported for most areas of the country. (Auth)

<1080>

Rogowski, A.S., and T. Tamura, Erosional Behavior of Cesium 137. 1970. Health Physics, 18, 467-477 (Oak Ridge National Laboratory, Oak Ridge, TN)

Movement of Cesium 137 by runoff, erosion, and infiltration on a siltloam soil in Tennessee is reported. A summary of a 2-yr study is given, and a model for the nuclide erosional loss is suggested. It was found that, although an empirical parabolic equation adequately describes the radionuclide loss, an exponential model, based on the nuclide distribution in a soil profile, appears to give more general results. The results show that a 60% reduction in the radiation dose due to surface-deposited Cs 137 occurred during the first 7 months following the application. Most of the applied radiocesium was found in the 0- to 3-cm layer or had been eroded away. It appears that the specific loss of Cs 137 reflects the seasonal variation in the magnitude of the erosion index and the extent of vegetative cover for a particular location. (Auth)

<1081>

Rogowski, A.S., and T. Tamura, Environmental Mobility of Cesium 137. 1970. Radiation Botany, 10, 35-45 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

During a 2-year study, erosion soil losses of 53, 2.5 and 0.9 metric tons/ha were coupled with Cs 137 losses of 43, 19 and 7 per cent, on 2.3 x 2.3 m bare soil, poor meadow and good meadow plots respectively. Runoff and erosion losses of Cs 137 from vegetation-covered plots occurred primarily in the initial stages following the application, due to washoff from vegetation, at a rate approximately ten times greater than would be expected on the basis of soil loss alone. Evidence of Cs 137 redistribution was determined by sampling and analysis techniques which facilitate a fair material balance. Uptake of Cs 137 by new vegetation was only a small fraction of originally applied Cs 137. An empirical relationship between cesium loss and soil loss of the form: $Y = 1(x/b)^n$, where Y = Cs loss, x = soil loss, b = a units constants, A = a coefficient and n = an exponent, fits the data well. These results indicate that movement of radionuclides by runoff and erosion may be quite important. (Auth)

<1082>

Rohleder, K., Investigations on the Uptake of

Radioactive Elements by Kale from Soil and Atmosphere and Attempts of Decontamination. 1972. Z. Lebensm.-Untersuch. Forsch., 149, 223-227 (Staatliches Chemisches Untersuchungsamt, Brunswick, German Federal Republic)

Investigations were reported on the uptake of Sr 90, Cs 137, and Zr 95 by kale and with attempts of decontamination. The surface of the leaves mainly took up Zr 95 and Cs 137 and the roots Sr 90. Apparently, the uptake of Cs 137 and Sr 90 from soil is related to the amount of precipitation. In spite of treating kale leaves with hot water for some time, decontamination was possible to only a small extent. (NSA)

<1083>

Romney, E.M., G.V. Alexander, G.M. Le Roy, and K.H. Larson, Influence of Stable Strontium on Plant Uptake of Strontium 90 from Soils. 1959. Soil Science, 87, 42-45 (University of California, School of Medicine, Los Angeles, CA)

Varied Treatments of Sr(NO3)2 and SrSO4 were applied to three different types of Sr 90-contaminated soil to determine to what extent stable Sr might reduce plant uptake of radiostrontium by the effect of carrier dilution. Applications of stable Sr at levels ranging from 0.1 to 5.0 me. Sr per 100 g. of air-dry soil increased the uptake of Sr 90 by beans and Ladino clover. Stable Sr displaced Sr 90 adsorbed on the soil exchange complex into the soil solution where it was more readily available to the plant. This effect was most apparent in an acidic soil containing a very low level of native Sr. Stable Sr uptake was linear with respect to the level of exchangeable Sr in the soil; however, the total amount of Sr accumulated by the plant was dependent upon the available soil calcium. Plants obtained more stable Sr from Sr(NO3)2-treated soils than from SrSO4-treated soils. The levels of stable Sr required to effectively reduce plant uptake of Sr 90 from soils by carrier dilution were greater than 5.0 me. Sr per 100 g. of soil, that is, equivalent to more than about 5 tons of Sr amendments an acre. (Auth)

<1084>

Romney, E.M., G.V. Alexander, H. Mishita, and K.H. Larson, Influence of Calcium and Strontium Amendments on Strontium 90 Uptake by Ladino Clover Upon Prolonged Cropping. 1961. Soil Science Society of America Proceedings, 25, 299-301 (University of California, School of Medicine, Los Angeles, CA)

Prolonged cropping experiments showed that a single application of CaCO3 in the amount recommended to produce better crop growth (2 to 5 tons an acre) continued to suppress Sr 90 uptake from an acidic soil that initially was deficient in plant-available Ca. This effect of treatment is attributable to the complementary influence of Ca on Sr. The cumulative amount of Sr 90 removed by 15 successive cuttings of ladino clover was 29.38, 15.71 and 11.61 percent of the dose from Sassafras sandy loam treated with CaCO3 at levels of 1, 5 and 20 me. Ca per 100 g. soil (equivalent to 0.5, 2.5 and 10 tons CaCO3 an acre, respectively.) The greatest amount of the Sr 90 dose removed from the single application of Sr(NO3)2 amendment at levels of 0.05, 1 and 2 me. Sr per 100 g. soil (equivalent to 0.05, 1 and 2 tons Sr(NO3)2 an acre) initially increased plant uptake of Sr 90 from Hanford sandy loam as a result of the displacement of Sr 90 from the exchange complex by stable Sr into the soil solution

<1084> CONT.

where it was more readily available to the plant. This enhancing effect of low levels of Sr amendment of Sr 90 uptake became less apparent as time progressed. The carrier-dilution effect of reducing plant uptake of Sr 90 from Hanford sandy loam was achieved by applying Sr (NO₃)₂ at a level of 10 me. Sr per 100 q. soil (equivalent to 10 tons Sr (NO₃)₂ an acre). (Auth)

<1085>

Romney, E.M., G.V. Alexander, W.A. Rhoads, and K.H. Larson, Influence of Calcium on Plant Uptake of Strontium 90 and Stable Strontium. 1959. Soil Science, 87, 160-165 (University of California, School of Medicine, Los Angeles, CA)

Additions of Ca reduced Sr 90 and Sr uptake by beans from nutrient solutions. Added CaCO₃ and CaSO₄ reduced Sr 90 and Sr uptake from an acidic, Sassafras sandy loam that was low in native Ca supply. Levels normally applied to this type of soil under good management (2 to 5 tons an acre) were most effective. The inhibiting influence of Ca on Sr 90 uptake persisted in Ladino clover over prolonged cropping periods. Neither form of applied Ca reduced Sr 90 or Sr uptake from a neutral, highly fertile Hanford sandy loam, or from an alkaline-calcareous sandy loam from Yucca Flat, Nevada Test Site. It appears that further additions of Ca will provide little protection against crop uptake of the radiostrontium fission products from Ca-rich soils. The Sr/Ca atom ratios and distribution factors for beans were dependent upon the concentration of these cations in the nutrient substrate and the method of assessing plant available Sr and Ca. When adequate levels of Ca were present for plant needs, the Ca content of the plant reached a maximum concentration. Upon further additions of excess Ca, the absorption of Ca proceeded at a reduced rate relative to the rate of Sr absorption, and a discrimination occurred in favor of Sr uptake. (Auth)

<1086>

Romney, E.M., and J.J. Davis, Ecological Aspects of Plutonium Dissemination in Terrestrial Environments. 1972. UCLA-12-848; 17p. (University of California, Los Angeles, CA; Nevada Operations Office, Las Vegas, NV)

The potential benefits to be derived for mankind from continued development of peaceful applications for plutonium cannot be denied. The technology of plutonium production and processing is already established, but the realization of its peaceful applications depends largely upon the development of methods for preventing its distribution in the environment. Because of safeguards and effective control measures, no accidental plutonium contamination of the public domain has imposed serious risks to a population group. Trace amounts of plutonium from above-ground nuclear detonations are contained in world-wide fallout; however, the levels of plutonium in foodstuffs and other components of the environment are insignificant compared to the amounts known to be hazardous. There has thus been very little interest in the study of ecological aspects of plutonium contamination. The result is a paucity of information on the behavior of plutonium in ecosystems and its radiological effects on natural fauna and flora. The Nevada Applied Ecology Group is embarked upon a program at the Nevada Test Site to investigate the long-range effects of plutonium disseminated into the desert ecosystem. Emphasis has been

placed upon standardization of analytical methods, delineation of contaminated areas, problems of resuspension and redistribution, food chain transport, and ecological effects. (Auth)

<1087>

Romney, E.M., W.L. Ehrler, A.H. Lange, and K.H. Larson, Some Environmental Factors Influencing Radiostrontium Uptake by Plants. 1960. Plant and Soil, 12, 41-48 (University of California, School of Medicine, Los Angeles, CA)

The amounts of Sr 90 taken up from vine soil varied among several different crop plants by a factor as high as 10 on the basis of dry weight. The relative decreasing order of Sr 90 uptake by mature plant tops was turnip-millet, swiss chard, ladino clover, broccoli, soybeans, barley, oats, wheat, spinach. For each of the cereal crops, the concentration of Sr 90 in the grain was only about one-fifth of the Sr 90 in the forage. The tubers of white rose potato grown on sassafras, Hanford and sorrento soils contained only about one-fiftieth of the Sr 90 concentrated in the tops. The Sr 90 uptake by potato was inversely correlated with the level of plant-available calcium in sassafras, Hanford and sorrento soils. Lowering of root temperature from 17 to 7 degrees centigrade significantly reduced Sr 90 uptake by barley and beans during a 24 hour absorption period. Q10 values indicated that strontium uptake was chemically controlled rather than the result of physical phenomena. A decrease in light intensity from 1,000 to 450 foot-candle significantly reduced Sr 90 uptake by barley and beans. The uptake of Sr 90 also was reduced as the light exposure period was decreased. One-third to one-half of the total amount of Sr 90 obtained during a 24 hour absorption period was taken up independent of exposure to light. (Auth)

<1088>

Romney, E.M., R.G. Lindberg, H.A. Hawthorne, B.G. Bystrom, and K.H. Larson, Contamination of Plant Foliage with Radioactive Fallout. 1963. Ecology, 44, 343-349 (University of California, School of Medicine, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

Studies of foliage contaminated with fallout from nuclear detonations showed that fallout particles less than 44 µ diameter were selectively trapped in the hairs and crevices and on resinous glands of the leaf surfaces. The beta activity from fallout lodged on plant foliage was correlated with the beta activity from fallout particles less than 44 µ diameter which were deposited downwind from the nuclear detonations. Although decontamination treatments did not remove all fallout particles from plant foliage, the levels of radioactivity which remained were less than half of the original after washing with mild detergents and chelating agents. Fallout on plant foliage that originated from tower-supported detonations was 5 to 35 percent soluble in 0.1 N HCl; fallout from balloon-supported detonations was 60 to 90 percent soluble. Radioisotopes of cerium, yttrium and zirconium contributed about 60 percent of the beta activity found in smaller than 44 micron-diameter fallout particles (90 days after detonation); radiostrontium accounted for nearly 5 percent and radiocesium contributed less than 1 percent. (Auth)

<1089>

Romney, E.M., H.M. Mork, and K.H. Larson,

<1089> CONT.

Persistence of Plutonium in Soil, Plants, and Small Mammals. 1969; 1970. UCLA-12-754; Health Physics, 19, 487-491 (University of California, School of Medicine, Los Angeles, CA)

A 10 year surveillance was made of the persistence of residual Pu 239 in soil, plants and small mammals indigenous to fallout areas contaminated with Pu 239 dispersed by high explosive detonations. Downward migration of fallout particles occurred in undisturbed soil profiles, and wind and water erosion accounted for some redistribution of the initial Pu 239 contamination. Long-term cropping experiments showed a relatively low degree of Pu 239 transfer from soil to plants but a consistent increase in its accumulation in plant tissue during a 5-year cropping sequence. Synthetic chelating agents enhanced plant uptake of Pu 239 from soil. The accumulation of residual Pu 239 in kangaroo rats and jackrabbits was highest in bone tissue; considerable amounts also were found in lung tissue. High levels found in the gastrointestinal tract indicate that ingestion is a major pathway through which residual Pu 239 entered into these small mammals. (Auth)

<1090>

Romney, E.M., J.W. Neel, H. Nishita, J.H. Olafson, and K.H. Larson, Plant Uptake of Strontium 90, Yttrium 106, Cesium 137, and Cerium 144 from Soils. 1957. Soil Science, 83, 369-376 (University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

Soil pot experiments were conducted in 1952 and 1953 to evaluate the capacity for barley, bean, carrot, lettuce, and radish plants to take up Sr 90, Y 91, Ru 106, Cs 137, and Ce 144 fission products from several different soils under greenhouse conditions. Results of these experiments show virtually no Y 91, Ru 106, Cs 137, or Ce 144 was taken up by these crop plants. Sr 90 was readily taken up and was concentrated in greatest amounts in leaf tissue. Radish tops generally accumulated the greatest amounts of Sr 90 per unit weight, followed by foliage of beans, carrots, lettuce, and barley, in decreasing order. Soil types influenced Sr 90 uptake. The highest Sr 90 levels were found in plants grown on acidic soils low in calcium and lowest levels on the alkaline-calcareous soils. The highest percentages of these fission products removed by crops from the soils studied were: Sr 90, 8.68 percent; Y 91, 0.03 percent; Ru 106, 0.13 percent; Cs 137, 0.48 percent; and Ce 144, 0.02 percent. On the basis of this investigation the ability of crop plants to take up relatively large amounts of Sr 90 might produce serious problems for agriculturalists in the event that soils are excessively contaminated with products of nuclear fission. Intensive cropping is apparently not effective for the removal of fission products from soils within a single cropping period; repeated cropping, however, might be fairly effective for decontaminating soils over a long period of time and more effective for acidic soils than for alkaline-calcareous soils. (Auth)

<1091>

Romney, E.M., W.A. Rhoads, A. Wallace, and R.A. Wood, Persistence of Radionuclides in Soil, Plants, and Small Mammals in Areas Contaminated with Radioactive Fallout. 1970. UCLA-12-816; CONF-710501-1; Part of Nelson, D.J. (Ed.), Proceedings of the Third National Symposium on Radioecology held in Oak Ridge, Tennessee, May 10, 1971, (p. 170-176), 1268 p. (University of

California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

The persistence of radionuclides in soil, plants, and small mammals was investigated periodically in areas contaminated with fallout from above-ground nuclear detonations at the Nevada Test Site. Study sites were established at various locations out to about 225 km from ground zero. Emphasis was placed upon the movement of Sr 90 and Cs 137 from abiotic to biotic components. Several neutron activation products also were studied in fallout areas located within 5 km of nuclear excavation tests. Radionuclides continued to be taken up through plant roots in small amounts as time progressed, and some continued to be deposited on foliage as resuspended dust particles. The inhalation route of entry became less important with passing time, whereas ingestion continued to be the most important route through which radionuclides entered small mammals living in old fallout areas. Long-lived Sr 90 accumulated primarily in bone tissue while Cs 137 accumulated in muscle and soft tissue. (Auth)

<1092>

Romney, E.M., A.J. Steen, R.A. Wood, and W.A. Rhoads, Concentration of Radionuclides by Plants Grown on Ejecta from the Sedan Thermonuclear Cratering Detonation. 1967. CONF-660405; Part of Aberq, B. and Hungate, F.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966, Pergamon Press, Oxford, England, (p. 391-398), 1051p. (University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

Native and domestic plants grown on ejecta from the Sedan thermonuclear cratering detonation, 6 July, 1962, concentrated very high levels of radiotungsten through their roots. Smaller, yet significant amounts of Sa 46, Mn 54, Co 60, Y 88, Sr 89, Sr 90, Zr 95, Ru 106, Sb 125, Cs 134, Cs 137, and Ce 144 also were concentrated through roots. Uptake of these radionuclides persisted through the 3 year cropping period of this study following the Sedan event; and the gamma spectrum continued to be dominated by Y 88, Zr 95, Ru 106, Ce 144, W 181 and W 185. Plant foliage contaminated by Sedan fallout also showed Rb 86, Y 91, Rh 102, Ru 103, I 131, Cs 136, Ba 140, Ce 141, Eu 152, and Eu 154; but these radionuclides were not concentrated through roots in later cropping experiments. Radioactive dust continued to be deposited on the foliage of plants re-established on Sedan ejecta after the detonation occurred. (Auth)

<1093>

Romney, E.M., R.A. Wood, and P.A.T. Wieland, Radioactive Fluorine 18 in Soil and Plants. 1969. Soil Science, 108, 419-423 (University of California, Los Angeles, CA)

Radioactive F 18 (112 min half-life) was useful for soil and plant experiments that could be completed within ten half-lives from its production. It was unsuitable for studying fluoride uptake by plants from soil because of its short half-life. Soils and minerals had different F 18 sorption capacities. The sorption of F 18 conformed to known reactions which were rapid in minerals having a small proportion of internal surface, such as kaolinite, and slow in minerals having a high proportion of internal surface, such as montmorillonite. Fluorine 18 was readily taken up by roots from nutrient media and translocated throughout alfalfa, bean and

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tomato plants where it concentrated more in leaf than in stem tissues. Stable fluoride and other non-isotope carriers inhibited root uptake of P^{18} . Foliar-absorbed P^{18} was distributed in a pattern similar to that from root uptake, except that it concentrated highest in young leaves and in young buds at the growing tips and leaf axils. The P^{18} absorbed by foliage was translocated to roots and released into nutrient media. Leaf tissue that had been damaged by ozone-oxidized unsaturated hydrocarbons (smog) did not accumulate P^{18} . (Auth)

<1094>

Romo, L.A., Beneficiation of Soils Contaminated by Strontium 90. 1959. Science, 129, 864-866

Criticisms are given of an article by W.F. Libby which appeared in Science 128, 1134 (1958). The article suggested that applications of potassium fertilizers depresses radiostrontium uptake in plants. (CWF)

<1095>

Ronzani, C.A., Evolution of Organic Matter in the Soil: Its Determination with Natural Carbon 14. 1968. Acta Cient. Venez., 19, 180-183 (University of Bonn, Bonn, German Federal Republic)

A new type of application of the C^{14} dating method is presented for the analysis of soils; pathways for mineralization are discussed. Three different types of soil were studied; from each of these six fractions were obtained: fulvic acids, humatmelanic acids, brown humic acids, grey humic acids, humine, and C-humus. The C was transformed into CSH_6 by a four-step procedure, and the activity of the benzene then determined. The route involves oxidation of organic material to CO_2 , reduction of CO_2 by Li to give Li_2C_2 , hydrolysis of the carbide to acetylene, and trimerization of the acetylene. The results obtained were compared with observations of other workers on the genesis of soil materials, and a path for formation of various soil components is discussed. Improvements of the technique suggested are being pursued. (NSA)

<1096>

Rose, G.B., C.D. Monk, and R.G. Wieqert, Accumulation and Transfer of Calcium 45 by the Biota of a Tagged Cornfield. CONF-670503; (p. 672-677) (University of Georgia, Athens, GA)

A study was made to determine distribution of calcium 45 within a corn crop at the Savannah River Plant and the transfer to old field weeds, insects, and soil. Corn seeds were soaked in a solution of calcium 45 and water prior to planting. At certain intervals content of Ca^{45} was measured in the corn, and the biomass samples centered around the corn. Two species of ladybird beetle, one species of ant, two species of leafhopper, and species of click beetle were used, and the Ca^{45} activity density was investigated during the summer months. Preliminary results show that any animal that contains isotope introduced into plants via tagged seeds must have eaten plants that have recycled the isotope; eaten portions of the tagged plants; eaten animals that have consumed parts of the directly or indirectly tagged plants; or picked up leachate directly. (NSA)

<1097>

Rosyanov, S.P., V.K. Vinogradova, L.I. Gustova, and L.I. Gedeonov, The Distribution of Strontium 90 and Cesium 137 in the Profile of Soils under Natural Conditions in 1964. A-AC-82/G/L-1169; AEC-tr-7214; (p. 82-86)

Data are presented on the vertical distribution of Cs^{137} and Strontium 90 in various soils in the USSR during 1964. Soil samples were taken to depths up to 30 cm. Determination of the Sr^{90} content was carried out by radiochemical analysis, while the Cs^{137} content was determined by the gamma spectrometric method. It was concluded that the vertical distribution of radioactive fission products in soils is determined by the chemical and physical properties of the radioisotopes and the occurrence of numerous migration processes. The efficiency of these processes depends primarily on the basic factors of soil formation such as the source rock, climate, topography, vegetation, etc. (NSA)

<1098>

Roth, J., and J.H. Blackburn, Fusion of Soils. 1967, July. SC-CR-67-2688; 99 p. (University of New Mexico, Albuquerque, NM)

A method is provided for predicting the melt ranges of soils with ensuing vapor and gas losses; previously determined soil mineral fusion data are correlated; test soils are selected which are representative of predominant and extreme soil types of the world with their mineralogical analyses and melt range predictions given; and the results of nine soil fusion tests are included. (Auth)

<1099>

Routson, R.C., An Evaluation of Predictive Methods of Determining the Effects of Solid-Liquid Phase Interactions on the Movement of Solutes in Soils. 1969, November. BNWL-1196; 14 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

An evaluation was made of the available methods, theories, and models which have been used to describe solid-liquid phase interactions that take place in porous media. Only the discontinuous-fixed plate model of Dutt was found to be a multicon approach which prior work on the Hanford project has shown to be necessary for a successful sorption description. The combination of Dutt's macroion approach and an empirical-statistical method of measuring trace radionuclide sorption was deemed to be the most fruitful approach for describing radionuclide concentration as a function of position and time. A computer program has been written and experiments have been designed to measure model parameters for testing the aforementioned approach. (Auth)

<1100>

Routson, R.C., Effect of the Prior Disposal of Uncontaminated Solution on the Waste Retention Capacity of a Hanford Crib. 1969. BNWL-1163; 18 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA)

An empirical method, suggested by constant head and moisture redistribution studies, was developed to predict the movement of a wetting front and a waste front in homogeneous sand columns due to pulse solution additions. The movements of wetting fronts and waste fronts were initiated by additions of equal pulses of aqueous solution. Movement of the wetting

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front was initiated prior to the initiation of the movement of the waste front. Log-log plots of the frontal position versus elapsed time were found to be linear for both wetting fronts and waste fronts for elapsed times up to 5000 hours. This demonstrates that the position of a front at time T can be empirically predicted by equations of the form $S = ET(E+F)$. Parameters E and F can be evaluated from laboratory measurements. Parameter E was found to be an extensive variable which increased with an increase in the amount of solution added as a pulse. Parameter F was found to be constant for a range of solution additions from 2.5 to 10% of the column volumes, suggesting that it may be an intensive variable. The position of the wetting front was found to move at a faster rate than the position of the waste front. Initiation of the waste front was found to increase the rate of movement of the wetting front. The observed decreased rate of movement of the waste front relative to the wetting front was interpreted as being equivalent to an increase in the waste retention capacity of the soil due to an initial addition of uncontaminated solution to the soil. In addition, moisture initially present in a soil need not be subtracted from the waste retention capacity because it will be displaced into the groundwater ahead of any disposed aqueous waste. (Auth)

<1101>

Rubtsov, D.M., Distribution of Thorium in Various Soils. 1966, March. Pochvovedenie, 3, 55-67

Different concentrations of thorium and its decay products in soils cause different levels of gamma radiation output above the surface of the soil mantle. The concentration of thorium in fine grain soil, that is, products of weathering and soil formation, is higher than in basement rock-schists with layers of quartzite. Increased concentration of thorium in the fine grain soil is related to processes of weathering and soil formation. The fluctuating concentration of thorium in the soil determines basically the concentration of thoron in the air near the ground. The presence of thorium in vegetable objects indicates that it is in the biological cycle in nature. The uptake of thorium in vegetative objects is determined not only by the concentration of thorium in the fine grained soil but is also regulated by the species of vegetative association and by the trend in the soil-making process. The processes of soil formation, characteristic of a bioclimatic zone, appear as the basic source of the transdistribution of thorium in the soil profile. (tr-Auth)

<1102>

Rubtsov, D.M., Distribution of Uranium and Radium in the Podzolic Mountain Soils of Thin Forests. 1972. Part of Verkhovskaya, I.N. (Ed.), Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh, Izdatel'stvo Nauka, Moscow, USSR, (p. 42-53) (Not given)

The content and distribution of uranium and radium in the profiles of podzolic mountain soils of thin forests were determined. A tendency was discovered to a preferential accumulation of uranium and radium in the products of soil formation (aleurite as compared with base rocks) by sericitic shists with quartzite intercalations. The presence of uranium and radium in the vegetative objects of forest litters confirms the already established fact that uranium and radium are

involved in the biological cycle of matter exchange in nature. The distribution of radium and uranium in soil profiles reflects the zonal features inherent in the given bioclimatic zone. In base rocks and soils, the equilibrium between radium and uranium is disturbed in favor of radium. In the order of decreasing energy of their absorption by vegetative objects radioactive elements form the series: radium > uranium > thorium. (Auth)

<1103>

Rubtsov, D.M., Thorium and Radium Content in the Silt Fraction of the Podzolic Mountain Soils of Thin Forests. 1972. Part of Verkhovskaya, I.N. (Ed.), Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh, Izdatel'stvo Nauka, Moscow, USSR (Not given)

Investigations have shown that in zones of ore manifestation, thorium is associated with the coarse dispersed part of aleurite. In the zone of the halo of dispersion and the zone of background areas, thorium represented by the fine dispersed fraction prevails. The distribution of the silty thorium fraction in different soil profiles is determined by the nature of soil forming processes and the thorium content of aleurite and correlates in a certain measure with the composition of the plant association. The presence of thorium in separate fractions of organic matter was ascertained. The amount of uranium in the soils considered varies within the range of the geochemical background of uranium content in the soils of the Russian plain. Uranium is confined mainly to the fraction >0.001 mm. The distribution of the uranium of the silty fraction along soil profiles is determined, like that of thorium, by the nature and trend of the process of soil formation. Uranium enters the vegetative objects of forest litters far more intensely than thorium. (Auth)

<1104>

Rubtsov, D.M., and E.I. Pravdina, Content and Distribution of Uranium, Radium, and Thorium in Mountain Tundra Soils. 1972. Part of Verkhovskaya, I.N. (Ed.), Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh, Izdatel'stvo Nauka, Moscow, USSR (Not given)

Investigations of the content and distribution of thorium, uranium, and radium in mountain tundra soils showed a differentiation of their content according to genetic soil horizons, determined by the nature of the processes of formation. The absolute biological accumulation of thorium and uranium was found to be lower in the soils of mountain tundras as compared with the more southern mountain tundra soils of thin forests. Against a background of a reduced absolute biological accumulation of thorium and uranium in mountain tundra soils, an increase is observed of the relative coefficient of the participation of thorium and uranium in the biological cycle of matter exchange. (Auth)

<1105>

Rusanova, G.V., Behavior of Radium and Calcium in the Soil-Plant System. 1964. Pochvovedenie, 3, 53-70

A study was carried out on strongly podzolic humus-ferroquinous, soddy-podzolic, and humose-gleyed soils contaminated with radium. A correlation was found between the radium and calcium contents in soil genetic horizons. Accumulation of radium by RANUNCULUS ACER,

<1105> CONT.

TARANACUM OFFICINALE WEBB, TRIFOLIUM PRATENSE L., and DESCHAMPSIA CAESPITOSA L. depends upon radium mobility in soils. Nearly all radium in the aerial part of the plants is available. (Auth)

<1106>

Rusanova, G.V., Radium Content of Soils in Regions With a High Radiation Background and the Effect of Fertilizers on Radium Mobility.. 1972. Part of Verkhovskaya, I.N. (Ed.), Radioekologicheskie Issledovaniya v Prirodnykh Bioqotsenozakh, Izdatel'stvo Nauka, Moscow, USSR, (p. 22-33) (Not given)

It was established that the radium content of gleystrognypodzolic soils in regions with a high radiation level is equal to 10 (E-7)%, that is by 4 orders higher than its Clark content in the soil. A certain part of the radium in the soil is in a mobile state and is carried with the downward water flow into the lower horizons. Experimental investigations in cultivated soddy-meadow soil have shown that radium mobility and its entry into plants are reduced by the application of organic fertilizers and lime. Superphosphate on the contrary enhances the mobility of radium. (Auth)

<1107>

Russell, R.S., Deposition of Strontium 90 and its Content in Vegetation and in Human Diet in the United Kingdom. 1958. Nature, 182, 834-839 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Experimental data gathered to date (1958), revealed that prediction of quantity of radiostrontium delivered to men via the human diet was not possible. The calcium content of soil is known to greatly effect strontium uptake by plants, but other factors such as growth forms of roots and aerial portions of plants may control radiostrontium content. (CWF)

<1108>

Russell, R.S., Uptake and Accumulation of Radioactive Substances in Terrestrial Plants - The Radiobiological Aspect. 1967. CONF-660405: Part of Aberq, B. and Hunkate, F.P. (Eds.), Radioecological Concentration Processes Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966 Pergamon Press, Oxford, England, (p. 367-382), 1051p. (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

A review evaluating the extent plant uptake contributes to movement of radionuclides into food chains is given. (CWF)

<1109>

Russell, R.S., An Introductory Review. Interception and Retention of Airborne Material on Plants. 1965. Health Physics, 11, 1305-1315 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

In a Symposium on Radiation and Terrestrial Ecosystems it is appropriate to discuss the interception and retention of airborne materials in plants only insofar as these processes influence the total radiation dose to which members of ecosystems may be subject. Consideration is given to the circumstances when this occurs and reasons are advanced why it is particularly relevant to consider those ecosystems which man has created or modified.

Quantitative information on the extent to which particulate deposits are retained on different types of plant surface is at present meager. The further study on this subject deserves encouragement since the external radiation dose, especially from beta radiation, which is received by tissues which are particularly sensitive to the effects of radiation could be greatly modified. The retention of finely divided deposits on crop plants and its subsequent loss of radioactivity due to mechanical and other processes have been studied in greater detail. Quantitative relationships are discussed with respect to those nuclides which are the major sources of internal radiation. Recent evidence suggests that the direct contamination of vegetation can be responsible for a still large fraction of the Sr 90 which enters food chains than was formerly supposed. (Auth)

<1110>

Russell, R.S., The Extent and Consequences of the Uptake by Plants of Radioactive Nuclides. 1963. Ann. Rev. Plant Physiol., 14, 271-294 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

A review is presented evaluating the role of plant uptake of radionuclides. (CWF)

<1111>

Russell, R.S., D.T. Clarkson, and F. Newbould, Tracer Studies of the Root Systems of Crop Plants. 1971. A/CNFP-49/P-506; CNFP-710901-225; Part of Proceedings of the 4th International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 6-16, 1971, 12 p. (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

The complex branching of plant root systems and their concealment in soil make them perhaps the most inconvenient of plant organs for detailed study; but tracer methods, some of which are discussed in this paper, now facilitate research on their physiology and interaction with soil. Relationships between the morphology of different parts of root systems and their ability to contribute to the nutrition of the whole plant can be studied in solution culture by the localized application of labeled nutrients to zones of roots which are enclosed in suitably designed cells. Nutrients contrast in the relative extent to which they are absorbed by different parts of root systems. Some, for example potassium and phosphate, enter all parts of the roots of cereal plants 2-3 weeks old; transfer to the stele is not prevented by thickening of the endodermis in the older zones. Microradioautographs and electron micrographs assist in interpreting these observations. In field experiments, on crops grown under normal agricultural conditions, the absorption of nutrients from different depths in soil can be examined by injecting tracers in selected positions and measuring the radioactivity which reaches shoots. Moreover the distribution of living roots can be studied by injecting rubidium 86 into shoots; it moves sufficiently uniformly to roots for their distribution to be shown by measurements of radioactivity in the soil. The use of these procedures is illustrated by investigations carried out, in collaboration with other Agricultural Research Institutes in England, on the effects of reduced cultivation on root growth in cereals and on root development in different varieties of cereals. Reduced cultivation holds promise of considerable

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<1111> CONT.

economy in production costs while information on the effects of genetically controlled variation in root structure may assist in the selection of new varieties. (Auth)

<1112>

Russell, R.S., and F.B. Ellis, Estimation of the Distribution of Plant Roots in Soil. 1968, February. Nature, 217, 582-583 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

The difficulty of measuring the distribution of living roots in soil is an obstacle to quantitative studies of the performance of root systems in natural conditions. Even the most careful procedures for separating roots from soil are subject to limitations. Errors occur especially in estimates of the distribution of the finer lateral roots, and it is often impossible to distinguish between living and dead roots. One approach to the problem is to use a radioactive tracer technique. Phosphorus 32 has been used in some studies, but has serious disadvantages. The studies described in this communication employed Rb 86 tracer in barley plants. The applicability of the procedure to other types of plants will depend on the extent to which the tracer is translocated to roots and on the uniformity of its distribution within the roots. Perennial woody species may present special problems. Amongst other applications it should be possible to demonstrate whether changes in agronomic practice alter the distribution of living roots, a question which is often of major interest. (Auth)

<1113>

Russell, R.S., and F.B. Ellis, The Movement of Strontium 90 through Food Chains. 1958. Soils and Fertilizers, 21, 269-273 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

A review is presented concerning the contribution soils play in the movement of strontium 90 through food chains. (CWF)

<1114>

Russell, R.S., and R.J. Garner, Uptake of Strontium by Pasture Plants and Its Possible Significance in Relation to the Fallout of Strontium 90. 1959. Nature, 183, 1806-1807 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England; Agricultural Research Council Field Station, Compton, Berkshire, England)

Evidence is presented which discredits the conclusion by Vose and Koontz (Nature, 183, 1447, 1959) that plant uptake of strontium 90 from soil in an all clover pasture will constitute a greater radiological problem in milk than that from an all grass pasture. (CWF)

<1115>

Russell, R.S., and G.M. Milbourn, Rate of Entry of Radioactive Strontium into Plants from Soil. 1957. Nature, 180, 322-324 (Agricultural Research Council, Field Station, Compton, Berkshire, England)

Data is presented showing the effect of management cultivation on the uptake of radiostrontium by plants. (CWF)

<1116>

Russell, R.S., and M.G.T. Shone, Movement of Strontium and Cesium in Soils and its Significance in Studies on the Contamination of Food Chains. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Experimental results are given of a long term study on the migration and fixation of strontium and cesium in several types of soil. These investigations were designed to approximate to field conditions in which the soil remained undisturbed by cultivation. The effects of the addition of nutrients and of a permanent crop of ryegrass grown on the artificially contaminated soils were also examined. The relevance of processes of migration and fixation to assessments of the uptake of strontium and cesium by crop plants is considered in the light of field experiments. (Auth)

<1117>

Russell, R.S., and E.M. Squire, The Absorption and Distribution of Strontium in Plants. I. Preliminary Studies in Water Culture. 1958. Journal of Experimental Botany, 9, 262-276 (University of Oxford, Department of Agriculture, Oxford, England)

The absorption and distribution of strontium in barley plants has been studied in water culture, both in the presence and absence of calcium. Tracer methods have been employed. When no other bivalent ions were present in the external solution the absorption of strontium was proportional to the concentration over a wide concentration range (10×10^{-6} to 10×10^{-1} mequiv/l). In the presence of calcium, however, absorption was reduced and appeared to be dependent on the total concentration of calcium plus strontium rather than on that of strontium alone. The translocation of strontium from the root to the shoot increased as the external concentration of both ions was raised. In plants of low initial calcium status the rate of translocation of strontium was markedly reduced, apparently because of its retention at or near the root surface. Autoradiographs of plants treated with labelled strontium for 24 hours at different stages of growth and grown subsequently for varying periods of time in unlabelled nutrient solutions showed that very little redistribution of strontium occurred within the plant. Leaves which developed after treatment in the labelled solutions contained little or no strontium even when the concentration in the older leaves was very high. Strontium was initially retained in the nodes of the stems, but the greatest accumulation was later found to be in the leaves which had been growing most actively at the time of absorption. (Auth)

<1118>

Rydskii, S.G., Accumulation of Strontium 90 Taken up from the Soil by Various Cultivated Plants under Field Experiment Conditions. 1969. A-AC-82/G/L-1296: 14 p. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

Data are presented on the accumulation of Sr 90 by plants in soil containing 1 Ci of Sr 90 per km² and an exchangeable calcium content of 1 mg/equivalent/100 g of soil. These data can be used to predict the accumulation of Sr 90 by crops of these plants. The soil was a

<1118> CONT.

heavy-loam chernozem. The Sr 90 content in nanoCi per kg are given in parentheses after the various plants for the grain part of the plant: spring wheat (5.5), barley (4.5), oats (5.9), kasan millet (1.6), foxtail millet (SETARIA ITALICA) (5.4), rye (3.0), buckwheat (10.2), Voronezh corn (3.4), Moscow corn (1.7), Capital pea (8.4), Nemchinovskii pea (5.4), Russian bean (11.2), feed bean (4.9), kidney bean (5.8), oil-bearing flax (23.1), mustard (43.3), cameline oil plant (30.7), sunflower (4.7), potatoes (1.7), sugar beet (9.4), carrot (5.4), and turnip (13.9). The vegetative mass contained a significantly greater amount of Sr 90 (a factor of 10 to 50 greater). If the Sr 90 content in the soil is known, these data can be used to predict the Sr 90 content in the crop. (NSA)

<1119>

Saas, A., P. Bovard, and A. Graubv, *Biologic Cycle of Manganese 54 and Cobalt 60 in a Soil*. 1971. *Kerntechnik*, 13(5), 230-232 (Commissariat a l'Energie, Centre d'Etudes Nucleaires, Radioecologie Continentale, Cadarache, France)

The first years data of the biologic cycle of manganese 54 and cobalt 60 in a brown calcareous soil common in the Mediterranean area is presented. Cobalt was found to be incorporated in soil organic matter to a greater extent than manganese. (CWZ)

<1120>

Saas, A., and A. Graubv, *Fixation and Migration in Soils of the Principal Products of Fission and Activation*. 1970. *Bull. Inform. Sci. Tech.*, 151, 55-65 (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Cadarache, France)

The work carried out by the Cadarache Radioecology Group on the subject of the fixation and migration of principal fission and activation products in soils is reviewed. This work includes a study of the factors involved during the fixation process: internal and external factors, nature of the vectors, rate of integration into the biological cycle, pedogenesis and the part played by certain dynamic constituents such as organic soil matter. This work, carried out both in the laboratory and in the field, has led to the development of a range of techniques which can be easily adapted to studies on environment and on soil pollution by chemical pollutants such as pesticides. (Auth)

<1121>

Saas, A., A. Graubv, and J. Anders, *Cycle of Some Radioelements in Natural Soils. Main Data for the Control of a Site*. 1972. EUR-4800; Part of Proceedings of an International Symposium on Radioecology Applied to the Protection of Man and His Environment held in Rome, Italy, September 7, 1971, (p. 381-393) (Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Cadarache, France)

Study of the decomposition of litter and the manner of introduction of radioelements into soil shows the role of these two factors in the development of contamination. Leaching by rain and foliar absorption by shrubby plants complete the cycle of development of radioelements and the data on the fixation and migration in the soil. The cycle of manganese, cobalt and cesium were studied. The integration of radioelements in the biological cycle depends on the manner of introduction. Leaching of radioelements by

rain represents: 10% for cesium, 8% for manganese and 4% for cobalt. These forms can be assimilated directly and are very mobile. The decomposition of plant debris progressively releases the mineral and organic elements in the course of the year. The migration in depth takes place according to the season and the elements released; this is also represented by a variation of the chemical forms present in the soil and the possibilities of absorption via the roots. In conclusion, the correlations obtained (development of soils, age and distance of sample take, access route) make it possible to draw up directives for rational control. (Auth)

<1122>

Sakauchi, K., *The Absorption and Transfer of Strontium and Calcium in Various Plants: Absorption and Distribution of Strontium in Plants*. VI.. 1964, June. *Nippon Dojo-Hiryogaku Zasshi*, 35, 206-209 (Miyazaki University, Miyazaki, Japan)

The absorption and distribution of Sr in various plants were compared with those of Ca. Various plants and vegetables, including cucumber, barley, corn, and radish, were cultivated in Ca-free solution. The five-day-old plants were removed from the cultures, and 2g samples of the roots were soaked in solutions containing 4 uCi Sr 89 and 12 uCi Ca 45/100 ml for 22 hr; roots were dried and the Sr 89 and Ca 45 assayed. Radioactivity uptake was highest in cucumber (Sr 89 9.49 and Ca 45 16.03 cpm x 10(E+5)/g dry wt) and decreased in radish, corn, and barley (Sr 89 0.89 and Ca 45 1.73). The discrimination factor of Sr 89 absorption to that of Ca 45 was 1.05 to 1.68. No plant showed a high specific absorption of Sr 89. Maximum absorption of Sr 89 and Ca 45 was observed in solutions of pH 7. There was no significant difference in adsorption of these two elements. The absorption of Sr 89 and Ca 45 through the leaves and their distribution were also studied by autoradiography. In this experiment, legumes were cultivated for 20 days and the second set of leaves was soaked in 1 ml of 2 uCi/100 ml Sr 89 and 1 ml of 3 uCi/100 ml Ca 45 solutions for six days. The autoradiographs showed that Sr 89 and Ca 45 were absorbed into the soaked leaves. However, there was no transfer of radioactivity to the other leaves. No significant difference in the absorption of these two elements by leguminous plants was observed. (NSA)

<1123>

Sakauchi, T., *Effect of Various Anions on the Transport of Strontium within Plants*. 1965. *Plant and Cell Physiology*, 6, 581-585 (Miyazaki University, Laboratory of Chemistry, Faculty of Liberal Arts and Education, Miyazaki, Japan)

With a view to finding a means of reducing contamination of food by radiostrontium, the inhibiting effects of various anions on the transport of strontium in plants were investigated. Pea and bean plants were pretreated with silicate, phosphate and nitrate ions, and the distribution of strontium in various parts of the plants was examined. In the case of pretreatment with silicate or phosphate ions, strontium absorption by the plant was decreased even if these anions were absent in the culture solution at the time of application of Sr 89. The absorption of strontium by the plants pretreated with nitrate ions was similar to that of the controls. Strontium absorbed by

<1123> CONT.

the plants pretreated with silicate or phosphate was found to be accumulated in the roots and its quantity transported to the aboveground parts was remarkably small; especially in the case of application of silicate, no measurable amount of strontium was transported to the upper parts of the plant. In the control and nitrate-pretreated plants, strontium absorbed in the roots was readily transported to the aboveground parts. (Auth)

<1124>

Sakanoue, M., and T. Tsuji, Plutonium Content of Soil at Nagasaki. 1971. Nature, 234, 92-94 (Kanazawa University, Department of Chemistry, Radiochemical Laboratory, Faculty of Science, Kanazawa, Japan)

Content of plutonium in undistributed soil samples in the vicinity of Nagasaki revealed that the activity is about ten times higher than other surface soil samples (4-3 mCi/Km²) due to long-range fallout from subsequent nuclear test explosions. (CWF)

<1125>

Salv, R., Use of Ultrasonic Vibration for Dispersing Soil Samples. 1967. Soviet Soil Science, 11, 1547-1559 (Zvolen Forest Technology Institute, Czechoslovakia)

Different conditions of sound-irradiation were studied with 9 different soil samples, and the effect of the different conditions on the degree of dispersion of the soil was observed. It can be stated that brief exposure to ultrasonics does not destroy the elementary particles of the soil. Dispersion is rapid, and the use of ultrasonics produces much better breakdown of the aggregates, cleaning of the surface of the larger particles, and separation of the coarse and fine separates than other methods of preparing samples. Sodium hexametaphosphate is recommended as the dispersing agent. The use of ultrasonics represents not only an improvement but also a significant speeding up and simplification of the preparation of soils for particle-size and other analyses, such as mineralogical analysis. (Auth)

<1126>

Samaniego, R., The Uptake of Strontium by Red Clover and Seradella as Affected by Different Calcium Compounds and Mineral Fertilizers. 1961. Forschung und Beratung, 10, 45-46

In pot experiments, the Sr uptake by the crops (higher on sand than on loamy sand of fair exchange capacity, and increasing with the Sr content in the soil) was much reduced by CaSO₄, CaCO₃, and CaCl₂ (in this decreasing order of efficiency); mineral fertilizers did not show such an effect, and P and Mg even tended to increase Sr uptake, by generally increasing yields rather than by any specific action on Sr. (Auth)

<1127>

Sandberg, G.R., J.S. Olson, and E.E.C. Clebsch, Internal Distribution and Loss from Roots by Leaching of Cesium 137 Inoculated into LIRIODENDRON TULIPIFERA L. Seedlings Grown in Sand Culture. 1969, September. ORNL-TM-2660; 68 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

Two-year-old tulip poplar seedlings were grown in heavily fertilized sand culture. Each seedling was inoculated with 1.5 microcuries

of cesium 137 and harvested at certain periods during the growing season. The subsequent distribution of cesium 137 in the plant, including the roots, was studied and was compared with the amount of cesium 137 lost from the root system by leaching with two rates of application of water. Dead roots were periodically collected, and the contribution of cesium 137 to the leachate from the death of roots was estimated. Approximately 32 percent of the inoculated cesium 137 was leached from the plants; root death accounted for one-fourth of this loss. The remaining 75 percent of the loss is credited to exudation and possible sloughing off of cells from the root cap. Exudation of cesium 137 did not increase with movement of cesium 137 to the roots during the growing season or to increased rates of water used to leach cesium 137 from the roots. (Auth)

<1128>

Sanderson, C.G., Determination of Radium 226 and Thorium 228 in Food, Soil, and Biological Ash by Multidimensional Coincident Gamma-Ray Spectrometry. 1969. Health Physics, 16, 747-753 (New York Operations Office (AEC), NY)

A multidimensional coincident gamma spectrometer was used for the direct determination of extremely low levels of coincident gamma emitting radionuclides in environmental samples. Both qualitative and quantitative analyses can be made with this spectrometer, which detects individual radionuclides that decay with the emission of cascading gamma rays. The sample is mounted between two primary 20 cm x 10 cm NaI(Tl) crystals, which are enclosed in a large cylindrical plastic phosphor anticoincidence shield. Only those events which occur in coincidence and are detected by the two primary crystals are recorded in the 4096 channel analyzer. This combination of coincident counting and anticoincident shielding reduces background by a factor of about 200. The application of this spectrometer to the determination of Ra 226 in various environmental media has given quantitative measurements which agree within 15 percent of those obtained by radiochemical methods. The calculated Th 228 in these samples agrees with radiochemical values for environmental samples reported by the UNSCEAR. (Auth)

<1129>

Saparyev, Ch., L.N. Zatschina, and L.N. Kalishina, Express-Method for Determining Strontium 90 in Plants. 1969. Izv. Akad. Nauk Turkm. SSR, Ser. Biol. Nauk, 6, 19-22 (Institute of Botany, Ashkhabad, USSR; Institute of Soil Science, Alma-Ata, USSR)

An express method of determining Sr 90 in plants that excludes the determination of yield of stable strontium carrier from duty cycle is described. It reduces considerably time wastes and provides accuracy. (Auth) (CO)

<1130>

Sartor, J.D., P.G. Kruzic, W.B. Lane, and J.L. Mackin, Experimental Investigation of Plant Uptake Contamination Factors, Final Report. 1968. AD-694531; 152 p. (Stanford Research Institute, Menlo Park, CA)

The uptake of four radionuclides Sr 85, Ru 106, Cs 137, and Ce 144 was measured for four plants (wheat, tomatoes, corn and potatoes) grown in four different soil types (sandy loam, sandy clay loam, silty clay and clay).

<1130> CONT.

Plants were grown in large soil containers that allowed most of the root system to develop under normal field conditions. Plant uptake contamination factors (aSU) were calculated for each sample harvested. Comparisons of the uptake for various plant part-soil-radionuclide combinations at crop maturity showed that the aSU values for Sr 85 were the largest in all instances, usually by an order of magnitude. The aSU values for the edible portion of each plant were lowest in every case, and usually the leafy portions of the plants had the largest aSU value. Additional experiments included measurements of changes in radionuclide uptake caused by available calcium levels, growing crops in large fields, and contaminant form and solubility. (Auth)

<1131>

Sauerbeck, D., and P. Fuehr, Experiences on Labeling Whole Plants With Carbon 14. 1966. JUL-389-LW: Part of Report of the FAO/IAEA Technical Meeting, International Soil Science Society Brunswick-Voelkenrode, September 9-14, 1963. Pergamon Press, Oxford, England, (p. 391-399) (University of Bonn, Kernforschungsanlage, Juelich, German Federal Republic)

Experiments with a simple and inexpensive C 14 growth chamber are described. It was not possible to raise small grain up to maturity at specific activities of 300 uCi/g C and above. Of several plant species tried at 1 mCi/g C only maize grew fairly well; even this exhibited some radiation injury symptoms. A perfectly uniform labeling within the plant can only be obtained if the plants are exposed to C 14 labeled CO2 of constant specific activity from the earliest seedling stage for at least several weeks. (Auth)

<1132>

Sawhney, B.L., Sorption of Cesium from Dilute Solutions. 1965. Soil Science Society of America Proceedings, 29, 25-28 (Connecticut Agricultural Experiment Station, New Haven, CT)

Sorption of Cs by a synthetic cation-exchange resin and by several clay minerals, over a range of low Cs concentrations, was studied in the presence of different counter-ions. An ion-exchange equation was used to predict the sorption of Cs from dilute solutions. Exchange isotherms showed that the sorption of Cs by the resin followed these predictions: Exchange isotherms were straight lines with unit slope. Sorption of Cs by clay minerals, however, did not follow these predictions except when K+ was the competing cation. When Ca2+ and Al3+ were the competing cations, the exchange isotherms for montmorillonite were straight lines with less than unit slope, showing that a larger proportion of Cs was sorbed with decreased Cs concentrations. The exchange isotherms of illite and vermiculite, on the other hand, had at least two distinct slopes suggesting that more than one type of exchange site is involved in the sorption of Cs by these minerals. These conclusions were also supported by estimates of the equilibrium constants calculated from Vanselow's equation. (Auth)

<1133>

Sawhney, B.L., Potassium and Cesium Ion Selectivity in Relation to Clay Mineral Structure. 1970. Clays and Clay Minerals, 18, 47-52 (Connecticut Agricultural Experiment Station, New Haven, CT)

Selectivity of a number of vermiculites, montmorillonites and micas for K and Cs ions was determined by sorption of these ions from equilibrium solutions of diverse concentrations. The selectivity coefficients were related to the layer charge density and the area of the frayed edges in layer silicates. Montmorillonites had the smallest selectivity for the two ions, while biotite and illite had the greatest selectivity. Selectivity of biotite and illite was limited to small concentrations of K, however. At greater concentrations the selectivity of vermiculite for K exceeded the selectivity of the micas. The greater selectivity of vermiculites than montmorillonites for K and Cs ions was attributed to the greater layer charge density in vermiculites. The greater selectivity of micas than montmorillonites and vermiculites was attributed to the frayed edges of micas in addition to their larger layer charge density. As the frayed edges in illite were increased in area by removal of the interlayer K the selectivity of illite for K also increased; thus confirming the selectivity of frayed edges for the K ions. (Auth)

<1134>

Sawhney, B.L., Selective Sorption and Fixation of Cations by Clay Minerals: A Review. 1972. Clays and Clay Minerals, 20, 93-100 (Connecticut Agricultural Experiment Station, New Haven, CT)

Investigations concerning selective sorption and fixation of K and similar cations by clay minerals and soil clays and the mechanisms of these reactions are reviewed. In particular, recent observations on selective sorption of these ions in dilute solutions by weathered micas and vermiculite in relation to the interlayer structures are discussed in detail. Also, implications of the resistance to weathering of small mica particles to cation selectivity by soils are described. Despite the increased understanding of sorption and fixation reactions, the following aspects remain unclear. First, the mechanisms of the collapse of alternate layers in vermiculite on K or Cs sorption has not been unequivocally established. Second, factors that impart stability to the central core of mica particles so that K extraction becomes progressively difficult are not known. Third, inability of Ca or Mg ions to expand interlayers of Cs-saturated vermiculite in contrast to K-saturated vermiculite is not completely understood. (Auth)

<1135>

Sawhney, B.L., Regularity of Interstratification as Affected by Charge Density in Layer Silicates. 1969. Soil Science Society of America Proceedings, 33, 42-46 (Connecticut Agricultural Experiment Station, New Haven, CT)

Successively larger sorptions of Cs or K by most Ca-saturated vermiculites collapsed their alternate layers, producing regularly interstratified mica-vermiculite layer sequences. Additional sorption then collapsed the expanded layers within the interstratified mineral until the entire sample was collapsed to the mica structure. Sorption of Cs or K by Ca-saturated montmorillonites, on the other hand, did not collapse their interlayers even when almost half of their exchange sites were occupied by Cs or K. Additional sorption then collapsed some layers producing random, not regular, interstratification. The ease of collapse of interlayers and the subsequent regularity of interstratification was related

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to the layer charge density of the mineral. The large charge density in vermiculite collapsed the layers readily on Cs or K sorption. The collapse in one layer prevents the entry of these cations in the adjacent layer, producing regularly interstratified mica-vermiculite layer sequences. The lack of collapse and the random interstratification in montmorillonites, on the other hand, is attributed to their small charge density. (Auth)

<1136>

Sawhney, B.L., Fixation of Cesium 137 by Soil Clays. 1968. N70-2955-15; 14 p. (Connecticut Agricultural Experiment Station, New Haven, CT)

The sorption and fixation of Cs by different minerals in soil clays were established. In addition, it was demonstrated that in the absence of Al-interlayers, the sorption of Cs by soil clays was governed by the dominant clay mineral. Studies were also made on the time course of the sorption of Cs by illite, montmorillonite, and vermiculite saturated with Ca or K. Investigations on Cs sorption by biotite and vermiculite mixtures and the manner in which Ca collapsed vermiculite interlayers showed that the greater the amount of vermiculite, the greater was the Cs sorbed. Thus, the contention that the selective sorption of Cs was associated with a 10A spacing was found to be incorrect. Also, the selective sorption of illite and other weathered micas was found to be associated with their frayed edges rather than the 10A spacing. (NSA)

<1137>

Sawhney, B.L., Kinetics of Cesium Sorption by Clay Minerals. 1966. Soil Science Society of America Proceedings, 30, 565-569 (Connecticut Agricultural Experiment Station, New Haven, CT)

Time course and the processes in the sorption of cesium from dilute solutions by illite, montmorillonite and vermiculite saturated with Ca or K and in the absence of excess saturating cation were investigated. Cesium sorbed by illite and montmorillonite quickly reached an approximate equilibrium; the Cs sorbed by montmorillonite did not change with time while the Cs sorbed by illite changed only slightly. On the other hand, the Cs sorbed by vermiculite did not reach an equilibrium even after 500 hr. Cesium sorbed by Ca-vermiculite continued to increase while the Cs sorbed by K-vermiculite decreased. Since the sorption of Cs by illite is limited to the external planar surfaces and interlayer edges only, equilibrium is quickly reached. Equilibrium in montmorillonite is attributed to its expanded lattice which makes all exchange sites equally available and permits exchange readily. The increased Cs sorption by Ca-vermiculite, on the other hand, is attributed to the different sorption rates by different exchange sites: initial fast sorption on external surfaces and edges followed by slow diffusion into the interlayers. The decreased Cs sorption by K-vermiculite is perhaps associated with the collapse of the partially hydrated vermiculite in suspension to 10A. (Auth)

<1138>

Sawhney, B.L., Cesium Sorption in Relation to Lattice Spacing and Cation Exchange Capacity of Biotite. 1967. Soil Science Society of America Proceedings, 31, 181-183 (Connecticut Agricultural Experiment Station, New Haven, CT)

Interlayer potassium from biotite was extracted with sodium tetraphenylboron for varying time intervals. Then, the cesium sorbed from 1- E-4M and 10-E6 M CsCl solutions by the original biotite and its altered products was determined. The increased removal of potassium successively increased the vermiculite component with expanded 14A lattice and a large CEC and decreased biotite with a collapsed 10A lattice and a smaller CEC. Further, the greater the amount of vermiculite and larger the CEC, the more was the Cs sorbed. Obviously, the expanded component with a larger CEC sorbed more Cs than its collapsed counterpart. These sorptions by mixtures of biotite and vermiculite, thus, do not support the contention that Cs is sorbed selectively by minerals with a 10A lattice spacing. (Auth)

<1139>

Sawhney, B.L., Sorption and Fixation of Microquantities of Cesium by Clay Minerals, Effect of Saturating Cations. 1964. Soil Science Society of America Proceedings, 28, 183-186 (Connecticut Agricultural Experiment Station, New Haven, CT)

Sorption and fixation of microquantities of Cs by six minerals, as affected by the saturating cations, were studied. Micas and vermiculite sorbed more Cs in the presence of Ca and similar divalent cations than in the presence of potassium and similar monovalent cations. Montmorillonite and kaolinite, on the other hand, sorbed more Cs in the presence of potassium than in the presence of Ca. While micas and vermiculite fixed a large proportion of the Cs sorbed, montmorillonite and kaolinite did not fix significant amounts of Cs against replacement by neutral salts. Thus, whereas Cs-sorption by montmorillonite and kaolinite appeared to be largely electrostatic, the sorption and fixation of Cs by micas and vermiculite was governed by the size and hydration, rather than valence, of the competing cation. Micas particularly exhibited a large fixation of Cs. It is suggested that the fixation of Cs by micas occurs at the crystal edges where Cs may replace potassium and thus become a part of the stable mica structure. (Auth)

<1140>

Sawhney, B.L., Unusual Sorption of Cesium by Vermiculite. 1966. Nature, 211, 893-894 (Connecticut Agricultural Experiment Station, Department of Soils and Climatology, New Haven, CT)

A hypothesis explaining the decreased adsorption of cesium by potassium-saturated vermiculite is presented. Evidence is presented that cesium being a larger ion than potassium, is slowly excluded from the 10 A collapsed interlayer lattice of potassium-saturated vermiculite. (CNF)

<1141>

Sax, N.I., and J.J. Gabay, Occurrence of Manganese 54 in Human and Bovine Livers. 1965. Health Physics, 11, 585-591 (New York State Department of Health, Division of Laboratories and Research, Albany, NY)

Data is presented to suggest that entry of manganese 54 into man is through foodchains rather than inhalation. (CNF)

<1142>

Scharpenseel, H.W., and W. Kerpen, Studies on Tagged Clay Migration Due to Water Movement. 1967. CONF-670641; STI/PUB-158; Part of Proceedings of a Symposium on the Use of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies held in Istanbul, Turkey, June 12-16, 1967, (p. 279-287) (University of Bonn, Bonn, German Federal Republic)

Fe 55-tagged clay minerals, produced by hydrothermal synthesis, serve to clarify the question whether clay migration or clay formation in situ is the predominating mechanism in the B sub t)-development of Parabraunerde (scl brun lessive, grey brown podsol, hapludalf, dernopodsol). They further indicate the possibilities of clay transportation caused by water percolation. Suitable experimental approaches, such as thin-layer chromatography and autoradiography, translocation tests in columns filled with monotypical textural fractions or with undisturbed soil profiles, and synchronous hydrothermal treatment of Fe 55-containing material from different horizons of Parabraunerde, to reveal the specific readiness of the different profile zones for Fe 55-clay production, are described. The possibilities of clay percolation are discussed. (Auth)

<1143>

Schauer, Th., W. Kreuzer, and H. Schmidt, Activity and Penetration of Cesium 137 in Various Soils. 1970. CONF-680672; Zentralbl. Veterinarmed., Beih., 11, 149-50; Part of Proceedings of the 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine held in Hanover, Germany (University of Munich, Munich, German Federal Republic)

Thirty-one soil samples from Bavaria, selected from 15 different environments: high moorland, low moorland, forest, and sand, were examined gamma-spectrometrically for Cs 137 contamination. At 10 of the 15 sites profile measurements were carried out to determine the depth of penetration of the Cs 137. Results showed that the soils with the highest organic content had the highest contamination, particularly high moorland peat soil. Poor sandy soils with low organic content (2-5%) are least contaminated. A clear correlation exists between Cs 137 contamination and humus content. In high moorland soils at 30 to 40 cm depth there was still more than 100 pCi/100 g Cs 137, whereas in sandy soils there were only traces even at 10 cm depth. (Auth)

<1144>

Scheel, H., and J. Kumert, The Strontium 90 Content of Soil and Plants in the Territory of the German Democratic Republic, 1964. 1966, August. SZS-7/66; 20 p. (Staatliche Zentrale fuer Strahlenschutz, Berlin, German Democratic Republic)

The results of Strontium 90 determinations in soil and plant samples in 1964 are presented. The Strontium 90 contamination of soil was determined to be about 30 nCi/m². Thus in comparison to 1963 the increase was about 7.5 nCi/m². With the exception of rye grain and cabbage no appreciable decrease of the Strontium 90 content could be observed in dried plant materials. No change of the Strontium 90 content could be detected in potatoes, whereas in beets even an increase of the Strontium 90 concentration was observed. For grass, green maize, and beet tops the ratio of Strontium 90 surface contamination to

Strontium 90 total contamination was estimated to be 69, 33, and 51 percent, respectively. These ratios correspond to a fallout retention of 17, 8, and 6 percent. The uptake of Strontium 90 from soil by grass and green maize was 0.6 and 1.1 percent. (Auth)

<1145>

Schell, W.R., T. Jckela, and R. Eagle, Natural Lead 210 and Polonium 210 in a Marine Environment. 1971. RLO-2225-T-14-4; IAEA/SM-158/47; CONF-720708-2; Part of Proceedings of a Symposium on the Interaction of Radioactive Contaminants with the Constituents of the Marine Environment held in Seattle, Washington, July 10, 1972

A regional sampling program was initiated to determine the existing levels of Pb 210 and Po 210 in sediment, organisms, and water from different depths in a salt water sound and a fresh water lake. The collections were made with plankton nets, midwater trawls, sediment corers, and a large volume water sampler consisting of 0.3 micron millipore filters and Al2O3 sorption beds (200 to 2,000 liters). The efficiency of collecting lead from fresh and salt water by the Al2O3 beds was determined. The sample analysis was made using Po 208 tracer for yield determination and low background alpha spectroscopy which separates the energies of Po 208 from Po 210; the ingrowth and decay of Po 210 were used to determine Pb 210. Computer programs were completed for data analysis, sorting, and retrieval. One interpretation of the early results of sample analysis from the fresh water and salt water environments was that the processes of erosion and leaching can contribute significantly to the concentration of Pb 210 and Po 210 in the aquatic environment. Regional differences were found which depend on the geological strata. Both the erosion process and the atmospheric fallout process must be considered as sources of these radionuclides in the aquatic environment. An unusually large concentration of Po 210 was found in the liver of a sablefish, ANOPILOPOMA FIMBRIA; the zooplankton in the same region also had a high Po 210 concentration. The nektonic crustacea have the highest Po 210/Pb 210 ratio of the organisms collected at ca 100. (Auth)

<1146>

Schilling, G., Strontium in Higher Plants. II. Distribution and Binding in Plants. 1960. Z. Pflanzenernaehr. Duenq. Bodenk., 91, 212-214 (University of Jena, Jena, German Democratic Republic)

Relative calcium and strontium uptake and distribution in various organs of pea plants was studied following addition of these radionuclides in different ratios to the soil. Results are given in tabular form. (ST)

<1147>

Schilling, G., and D. Richter, On the Content of Strontium 90 and Yttrium 90 in Soil in Central Germany. 1964. Albrecht-Thaer-Arch., 8, 107-125 (Friedrich-Schiller University, Jena, German Democratic Republic)

Solutions of carrier-free mixtures of Strontium 90-labeled SrCl2 and Yttrium 90-labeled YCl3 were added to soils and to model substances (ferric hydroxide, Al(OH)3, quartz sand, silicic acid, kaolin, and bentonite) to study the binding of the two radionuclides to soil constituents on the basis of their extractability. The various

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soils and the model substances tested adsorbed Strontium 90 and Yttrium 90 to an extent whereby it was almost impossible to extract them with distilled water at neutral pH. Adsorbed Yttrium 90 could only be displaced by saline solutions in the acid range, and only up to pH 5.0. It was tightly bound to the carrier as a colloid and could not be exchanged if the pH value was higher than 5. In contrast to Y 90, Sr 90 was found to be exchangeable in all experiments performed, but was slightly more difficult to displace with cations than calcium. Oat plants absorbed Sr 90 and Ca in the ratio to be expected from these interchange-ability differences. Wash-out experiments that were performed in soil in situ indicated that the depths to which Sr 90 penetrates into the soil and the extent to which it is washed out depend on the exchange capacity of the soil and on the electrolyte content of the soil solution. The results are discussed in relation to radioactive fallout contamination of soil. (NSA)

<1148>

Schmalz, B.L., and W.S. Keys, Retention and Migration of Radioactive Isotopes in the Lithosphere at the National Reactor Testing Station-Idaho. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Idaho Operations Office, Health and Safety Division, Idaho Falls, ID)

The National Reactor Testing Station is located in a desert plain underlain by Tertiary and Quaternary basalt. The regolith is composed of wind and water laid sediments usually not over 20 meters deep. The climate is cool and arid and the soils are classified with the Sierozem group. The regional water-table is in aquifers in the basalt at an average of 140 meters below the land surface. Aqueous liquids containing mixed fission and activation products in a concentration of the order of $10(E+3)$ $\mu\text{Ci}/\text{ml}$, are routinely discharged to ponds excavated in the alluvial regolith. Migration of radioisotopes through the regolith and basalt is delineated by samples from drill holes. The water and isotopes have been detected in the regolith at distances of 150 meters from the MTR-ETR disposal pond. The waste has been detected in perched water in the basalt at distance up to 1.5 kilometers. The following migrating isotopes have been identified: tritium, chromium 51, cobalt 60, iodine 131, cerium 144, ruthenium 106, silver 110. Tritium, chromium 51 and cobalt 60 have been observed to be particularly migratory. The migration of cobalt 60 and cesium 137 has also been observed at other plant areas. The concentration of tritium diminishes with distance from the disposal pond. Because disposal is to the zone of aeration this cannot be explained on the basis of dilution. Ion exchange has been substantiated by laboratory studies. Columns filled with natural earth materials have shown that significant attenuation of tritium does occur despite relatively small cation capacities. Migration of contaminated ground water resulting from disposal of waste at the NRTS is most extensively mapped on the basis of tritium analyses. Concentrations of $10(E+6)$ tritium units (T.U.) have been discovered at distances of 210 meters from a disposal well. Attenuation of the concentration to 1,200 T.U. at distances of 5 kilometers from the disposal point is observed. Attempts to trace contamination in ground water beyond 400

meters on the basis of isotopes other than tritium have been unsuccessful. Chemically contaminated wastes have also been traced to a distance of 5 kilometers. (Auth)

<1149>

Schmalz, B.L., and W.L. Polzer, Tritiated Water Distribution in Unsaturated Soil. 1969, July. Soil Science, 108, 43-47 (Idaho Operations Office (AEC), Idaho Falls, ID)

On the basis of tritium concentration measurements in soil water, it was concluded that approximately 3.5 percent of the tritium which occurred at the Southeastern Idaho location during a 15-year period remained in the top 200 centimeters of the soil profile while the rest was lost by evaporation or transpiration. The observed distribution compared with that calculated by a mathematical model based on diffusivity and convective processes. Diffusivity values acceptable by the model varied within a range of 0.9×10 (E-6) to 9×10 (E-6) cm^2/sec . Acceptable values for velocity varied within a smaller range of 8 to 10.4 cm per three-month period. (Auth)

<1150>

Schofield, J.C., Origin of Radioactivity at Niue Island. 1967. N.Z. J. Geol. Geophys., 10, 1362-1371 (New Zealand Geological Survey, Papatoe, New Zealand)

Origin of the high soil radioactivity on Niue, an isolated island in the South Pacific, is discussed. The high radioactivity of the Niuean soils is similar to that found in deep sea sediments. Ionium and Ra 226 are the source of the bulk of the radioactivity on Niue. Because of the greater solubility of U, separation from the daughter products occurs in seawater, the high radioactive content in deep sea sediments being due to a slow rate of clastic deposition compared with the deposition of shelf sediments. The rate of sedimentation in deep sea areas is unlikely to have been as rapid as in the now dry lagoon at Niue; hence, a seawater origin for the abnormally high radioactivity at Niue is unlikely. A separation from U of the daughter products also takes place in hydrothermal solutions which could have come from the volcanic substructure at Niue, possibly phonolite, one of the most radioactive igneous rocks. The anomalous distribution of radioactive soil values at Niue favors a volcanic origin rather than a seawater origin. Evidence is also presented that radioactivity in the limestone was derived from groundwater and not percolating rainwater. Groundwater is the main source of freshwater at Niue and if hydrothermal activity is still present, the groundwater may be injurious to health and should be tested for radioactivity. (NSA)

<1151>

Schofield, R.K., and I.J. Graham-Bryce, Diffusion of Ions in Soils. 1960. Nature, 188, 1048-1049 (University of Oxford, Department of Agriculture, Oxford, England)

Analytical techniques used for the measurement of cationic diffusion in soil systems are presented. (CWE)

<1152>

Schroeder, D., and G. Bussche, Competition of Calcium, Hydrogen, and Strontium Ions in Adsorption of Active and Inactive Strontium in Soil. 1962. Landwirt. Forsch., 15, 190-195

<1152> CONT.

(Christian-Albrechts-Universität, Kiel, German Federal Republic)

The relative uptake and exchange values of Ca and Sr in so called Ca type and Sr type soils were examined in relation to changes in pH. Within a concentration range of 100 μ equiv inactive Sr to 0.5 μ Ci radioactive carrier-free Sr per 100 g soil, adsorption of both macro and micro quantities follows the same general laws. When Sr is adsorbed by a Ca type soil, its greater affinity for the exchange sites relative to Ca (due to its greater ionic dia and lower degree of hydration) is masked by a hysteresis effect; this effect inhibits the exchange of the ions already adsorbed; hence the weaker adsorption of Sr ions as compared with Ca ions, in Ca soils. Given a constant metal ion and a decreasing H ion concentration, adsorption of Sr increases over the entire pH scale. If the concentration of metal ions is low and increases with the pH, Sr adsorption increases only within the very acid pH range (up to about pH 5). The influence of pH between pH 5 and 8 is slight, while above pH 8, in the presence of a high concentration of alkaline earth ions, the adsorption of Sr again declines. (NSA)

<1153>

Schroeder, D., and J. Guenther, The Uptake of Radioactive Strontium 89 by Forage Plants from Soils of Schleswig-Holstein and from Model Soils. 1966. CONF-660912-4; IAEA/SM-77/39; Part of Proceedings of the FAO/IAEA Symposium on the Use of Isotopes in Plant Nutrition and Physiology Studies held in Vienna, Austria, September 5-9, 1966 (University of Kiel, Kiel, German Federal Republic)

Pot experiments were made in order to investigate the uptake of strontium 89 by rye grass and white clover from 19 soils varying in exchangeable calcium, pH, exchange capacity, and content of clay and organic matter. From the total strontium 89 given to each pot, 0.04 to 0.45 percent strontium 89 was found in one g of dry plant substance, with an average of 0.20 percent in rye grass and 0.25 percent in white clover. The strontium 89 content of the plants significantly increased with increasing amounts of exchangeable Ca, and decreased with increasing pH, exchange capacity, and clay content. Compared with the Ca content of the plants, the Sr content significantly decreased with increasing pH and exchangeable Ca, whereas there was no significant relation with exchange capacity, clay and peat content. Compared with the Sr/Ca ratio in soil mixtures, the corresponding ratio in clover decreased with higher pH. (NSA)

<1154>

Schroeder, G.L., H.W. Kraner, and R.D. Evans, Diffusion of Radon in Several Naturally Occurring Soil Types. 1965, January. J. Geophys. Res., 70, 471-474 (Massachusetts Institute of Technology, Cambridge, MA)

Experimental values of the diffusion coefficient for Rn 222 in several naturally occurring soils are presented; 0.03 cm²/sec appears to be a fair approximation of the true value for moderately dry, sandy soils. In at least the upper 30 cm of some soils convection and diffusion are the mechanisms which remove radon from these shallow layers. Concentrations of Rn 220 in several soil and rock environments are listed. (Auth)

<1155>

Schufle, J.A., Effect of Complexing Agents on the Order of Cation Exchange on Kaolinite. 1957. Soil Science, 84, 323-328 (New Mexico Institute of Mining and Technology, Socorro, NM)

In the absence of complexing anion, the order of cation exchange on kaolinite is Th > La > Ca > K, as given by Gieseking and Jenny. When a complexing agent such as citrate ion or fluoride ion is present in concentrations of 0.01 N, the order of exchange is K > Ca > La > Th, exactly the reverse of the normal order. Organic acids such as are found in humus are usually of the type which are good complexing agents. The uptake of potassium by clays in the soil should be promoted by the presence of such organic acids. It is possible that potash fertilizers could be used more efficiently if complexing agents, either organic or inorganic, were added at the time of application to the soil. (Auth)

<1156>

Schufle, J.A., Soil Stripping for Removal of Strontium 90. 1961. Texas Journal of Science, 13, 3-6 (New Mexico Institute of Mining and Technology, Socorro, New Mexico)

Consideration is given to the problem of removal of Sr 90 from the soil. This leads to the suggestion that perhaps one of the cheapest ways of removing the strontium might be through the use of complexing agents in solution. (Auth)

<1157>

Schulz, R.K., Recovery of Telluric Acid from Iodine 131 Production Waste. 1965. Health Physics, 11, 1317-1324

Biological importance of radionuclides found in the soil is determined by half-life and by mobility of the nuclides in soil. Further, the amount and species of complementary ions in a soil mass strongly influence the redistribution of nuclides in the soil profile and will affect their uptake. (NSA)

<1158>

Schulz, R.K., J.P. Moberg, and R. Overstreet, Some Experiments on the Decontamination of Soils Containing Strontium 90. 1959. Hilgardia, 28, 457-475 (University of California, Agricultural Experiment Station, Berkeley, CA)

A series of experiments were conducted to determine the most effective method for decontaminating soil of radioactive strontium. These included leaching experiments, physical immobilization by "lifting" the surface contaminated soil with asphalt emulsions, and placement of contaminated soil within the soil profile. (CWF)

<1159>

Schulz, R.K., R. Overstreet, and I. Barshad, On the Soil Chemistry of Cesium 137. 1960. Soil Science, 89, 16-27 (University of California, Berkeley, CA)

The data indicates that carrier-free cesium may be fixed in soils by way of a precipitation of the element on surfaces of micaceous minerals. That is, in the precipitation the existing crystal lattice is altered or extended slightly so that the cesium is incorporated in a crystal structure. Also, even though this structure is continually dissolving and reforming,

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microscopically, the cesium cannot be released by exchange for H^+ , Na^+ , Ca^{++} , Mg^{++} , or Ba^{++} , because these ions do not fit into the crystal lattice. On the other hand, because of the microscopic dissolving and reforming, cesium is released to some extent by K^+ , NH_4^+ , and Cs^+ , since such ions can substitute for cesium in the crystal. (Auth)

<1160>

Schulz, R.K., R. Overstreet, and K.L. Babcock, On the Soil Chemistry of Radio Strontium. 1958. Hilgardia, 27, 333-342 (University of California, Agricultural Experiment Station, Berkeley, CA)

The authors concluded that essentially all the strontium 85 added to 26 California soils was present in the soil as exchangeable or water soluble form, regardless whether the soil was calcareous or acid. If a soil reaction product is formed in which the strontium availability to the plant is lowered, the formation of such a product must be a long-term process. (CWF)

<1161>

Schulz, R.K., and H.R. Biedel, Effect of Aging on Fixation of Strontium 90 by Soils. 1961. Soil Science, 91, 262-264 (University of California, Berkeley, CA)

With the passage of several years a small fixation of Sr 90 was found to exist in a nonexchangeable form in soils. This fixation probably takes place, in part, by incorporation in $CaCO_3$ crystals when soils contain this material. In all soils studied, fixation appears to be caused by entry of the Sr 90 into such solid phases as strontium or calcium phosphates or other crystals containing strontium or calcium. (Auth)

<1162>

Schulz, R.K., G.A. Tompkins, and K.L. Babcock, Uptake of Plutonium and Americium by Plants from Soils. 1974. UCB-34-P-211-1; 19 p. (University of California, Department of Soils and Plant Nutrition, Berkeley, CA)

As part of a research project to study the uptake of plutonium and americium by plants from soils, five California agricultural soils were collected and analyzed as to pH, parent material, and organic matter content. Two soils contaminated with plutonium and americium and two paired control soils were collected from the Nevada Test Site. A method was developed which allowed uniform blending of the nuclide being studied with the experimental soil. Future studies will concentrate on plant uptake from previously contaminated soils and from soils where the nuclide has been added in various chemical forms. Particle analysis of the Pu 239 particles contained in Nevada Test Site soils will also be carried out. (ST)

<1163>

Scott, A.D., Exchange of Interlayer Cations in Micaceous Minerals, Progress Report, August 1, 1973 - July 31, 1974. 1974. COO-1680-20; 16 p. (Iowa State University, Ames, IA)

The sorption and exchange of cations on interlayer sites of micaceous minerals has been studied in terms of six distinct subdivisions. 1) Comparisons of Cs sorption by degraded micas in acetone or boiling solutions have shown the interlayer cation population can be variable and a factor

governing the exchangeability of added Cs. Ways of producing Na-degraded mica with negligible K for controlled Cs sorption experiments have been developed. 2) Determinations of maximum levels of indigenous Cs, Rb and K exchange in lepidolite support the idea that these cations occur in a random distribution throughout each interlayer space. 3) A look at interlayer cation exchange with solutions that have a composition comparable to real radioactive wastes has been initiated with emphasis on the effects of Al. 4) As much as 80% of the octahedral $Fe(+2)$ in mica has been oxidized by $Br(2)-NaCl$ solutions, whereas lesser amounts of oxidation occurred when expansion was controlled by K. 5) Detailed exchange studies with heated micas have identified a retardation effect of heat on dehydroxylated muscovite and correlation with $Fe(+2)$ oxidation in lepidomalane. 6) The elimination of small particle effects with large mica-solution ratios has been re-examined. (Auth)

<1164>

Scott, A.D., and P.T. Ismail, Exchange of Interlayer Cations in Micaceous Minerals. 1971. COO-1680-13; 21 p. (Iowa State University of Science and Technology, Department of Agronomy, Ames, IA)

The following areas of work have been emphasized: Cs sorption and exchange in degraded mica; occurrence and exchange of indigenous interlayer Cs and Rb; separation of Cs, Rb, and K from TPB; interlayer cation exchange in heated micas; and effects of structural Fe on interlayer cation exchange. Cs degraded mica samples with more than 75% of the layer charge satisfied by Cs were prepared by the simple procedure of degrading the mica with NaTPB solutions, terminating the degradation treatment with $CsCl$ and separating the mineral from TPB compounds by salt solutions. The layer charge and interlayer cation population of the degraded mica, however, varied with specific aspects of the procedure and must be considered in the interpretation of Cs exchange data. The exchange of Na by Cs in the preparation of Cs degraded lepidomalane and the subsequent exchange of Cs in air-dry, 110 C-dry and 450 C-heated samples seem to follow the same pattern as that observed with K under the same circumstances. A comparison of the exchange of Na for Cs and K in the same degraded mica particles has provided new and interesting information about the distribution a mixture of added Cs and K might have in the interlayers but has also emphasized the need to include the population and distribution of cations in a consideration of the kinetics of interlayer cation exchange. Micas can contain appreciable amounts of indigenous interlayer Rb and Cs as well as K. By studying the exchange of these indigenous cations in the same sample, information on their distribution in the interlayers, comparisons between the cations, and comparisons with fixed cations can be obtained. The distribution and exchange of Rb and K in the interlayers of a lepidolite sample were found to be very much alike. A method of using boiling salt solutions that contain $CuCl_2$ instead of $HgCl_2$ to redissolve the K, Rb, and Cs that has been extracted from the mica and precipitated by NaTPB has been developed and shown to have many advantages. Besides avoiding the pollution aspects of using Hg, the Cu method yields clear solutions, which denote the end of the process and permit the recovery of the degraded mica, and requires a volume of only 70 ml, which make the determination of small

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amounts of exchange (as occurs with indigenous interlayer Cs in some micas) possible. By studying a wide variety of micas, it has been observed that prior heating may increase, decrease, or not change the exchangeability of the interlayer K. With muscovite, prior heating enhances the exchange of K, not by exfoliation as might be expected, but by increasing the rate of edge weathering. The effect of heat on trioctahedral micas increases with their Fe content and a close relationship between the changes in Fe(+2) oxidation and K exchangeability in heated samples have been observed. A comparison of the K exchange and Fe(+2) oxidation that occurs when lepidomelane particles (257 moles Fe(+2)/100 g) are placed in KCl or NaCl-NaTPB solutions that also contain H₂O₂ have shown the chemical oxidation of Fe in micas depends upon the expansion of the mica. Only 1% of the Fe(+2) in contracted mica is oxidized whereas 90% of the Fe(+2) may be oxidized by H₂O₂ if the sample is completely expanded. Still, the exchange of K seems to be enhanced by the presence of H₂O₂ in the extracting solution. NaOCl is a much less effective oxidant for Fe(+2) in mica. (Auth)

<1165>

Scott, A.D., and S.J. Smith, Exchange of Interlayer Cations in Micaceous Minerals. 1967. COO-1680-3; 9 p. (Iowa State University, Department of Agronomy, Ames, IA)

The following areas of work are described: comparison of interlayer K replacement by various replacing cations (Li, Na, Mg, Ca, Sr, and Ba) in Na/Pb extracting solutions; conversion of bulk samples of Na-degraded micaceous minerals to other cationic forms; effect of particle size on the exchange of interlayer K in micas; exchangeability of K in naturally fine-grained micaceous minerals (including soils and soil clays) and developing methodology (including equipment) for the determination of hydration characteristics of degraded micas. It was found that interlayer K exchange can occur in the same mineral particle by two mechanisms, edge or layer weathering, and that the extent to which each mechanism is involved determines if all or only a part of the K is replaceable. Edge weathering, which is predominant in large particles, allows all the K to be exchanged. As the particle size decreased, layer weathering increased and the amount of exchangeable K decreased. This effect of particle size was established with dry-ground micas and soils (with naturally fine-grained micaceous minerals). These results are pertinent to concepts regarding natural weathering of micas and the release of nonexchangeable soil K to plants. (Auth)

<1166>

Scott, R.R. (Ed.), Other Fission Products, Induced Activities, and Fissile Materials, 1966. Part of Radioactivity and Human Diet, Pergamon Press, New York, New York, (p. 353-363) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Although Sr 90, Cs 137, and I 131 are the three radioisotopes of most concern to us now, we cannot neglect other radioisotopes that, in the event of an industrial accident, may become important contaminants of foodstuffs. These radioisotopes may be classified into three groups: fission products, induced activities, and fissile materials. Included among the fission products of potential importance are Ba 140, Ru 103, Ru 106, Zr 95,

Ce 144, Te 132, and Te 131. Each has been detected to varying degrees in foodstuffs, but none of them has as yet been considered a dietary hazard. The radioisotopes of induced activity include: Zn 65, Mn 54, Fe 55, P 32, and S 35. These isotopes have sufficiently long half-lives to constitute a potential hazard, but their low radioactivity consigns them to this category of secondary importance. The fissile (fissionable) materials include the various ionic forms of Pu 239. Its long half-life combined with the fact that it is among the most hazardous of isotopes, encouraged much inquiry into its behavior in soil over long periods of time. Studies have indicated however, that it is not readily taken up by plants and it is absorbed to only a very small extent from the gastrointestinal tracts of animals. (NSA)

<1167>

Seher, A., and G. Buerjes, On the Determination of Cesium 137 in Oil-Bearing Seeds and Fruits. 1968. Fette-Seifen-Anstrichm., 70, 53-58 (Bundesanstalt fuer Fettforschung, Munster, German Federal Republic)

A wet extraction procedure, which is faster and less susceptible to interference than the earlier method based on careful ashing, was developed for the determination of Cs 137 in seeds and fruits containing oil. An ion exchanger based on K cobaltferrocyanide was employed for concentration of dissolved Cs and for separation for impulse measurements. Analyses made by this procedure show much smaller errors than the earlier methods. Detailed instructions for wet extraction with 4M HCl, for removal of PO₄(-3) with Ca(+2), for Cs precipitation by molybdophosphate, for precipitation by hexachloroplatinate, for concentration by ion exchange (details of an apparatus for this purpose are described and illustrated), and for calibration of the exchanger samples with Cs 137 are all described. Using the three different methods for syntheses of the ion exchangers mentioned above, the calibration factors agreed within 25%. Results for linseed oil, palm seeds, and soybeans gave data within 3.5% of accepted values, as tested by an addition procedure. (NSA)

<1168>

Sen'ko, E.E., Exhalation of Radon 220 and its Content in the Air. 1967. Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana, 3, 1023-1025 (Kiev State University, Kiev, USSR)

A method and results of measuring the radon 220 exhalation from the ground and its content in the lower atmosphere are discussed. The results of 38 measurements of Rn 220 exhalation carried out in a dug up field during a dry season during August to November of 1966 showed a mean Rn 220 exhalation of 0.023 atom/cm²-sec (or 80 x 10¹⁰ (E-16) C/cm²-sec) with the order of error of 30 to 40%. Simultaneous measurements of Rn 220 concentration in the air, 1 m over the ground indicated the presence of 2.5 atom/liter (or 86 x 10¹⁰ (E-14) C/liter), which is in agreement with published experimental data. (NSA)

<1169>

Sen'ko, E.E., and B.G. Starikov, Evaluation of Thoron Exhalation. 1968, March. Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana, 4, 367-368

A simplified method is suggested for evaluating the amount of thoron exhalation under various local soil conditions. The

<1169>

<1169> CONT.

thoron exhalation method is based on the measurement of radon and thoron concentrations in soils and exhalation of the radon. The results are analyzed and compared with results from other methods. (NSA)

<1170>

Senvar, C.B., and O. Birkul. Adsorption of Strontium 90 by Soil. 1965. Atcmapraxis, 11, 389-391 (University of Ankara, Department of Physical Chemistry, Ankara, Turkey)

The adsorption of strontium 90 to three soils; a sandy soil, calcareous soil and clay soil, were evaluated. (CNF)

<1171>

Shainberg, I., and W.D. Kemper, Ion Exchange Equilibria on Montmorillonite. 1967. Soil Science, 103, 4-9 (Colorado State University, Agricultural Experiment Station, Fort Collins, CO)

According to standard diffuse double-layer theory, the affinity of clay for the various alkali ions should be the same. Experimentally, it is found that the bonding forces holding the monovalent cations is usually $Cs^+ > K^+ > Na^+ > Li^+$. The amended diffuse double-layer theory proposed by the authors, combined with the ion-pair formation concept, was used to predict equilibrium constants for monovalent ions adsorbed on montmorillonite clay. Predicted and measured values of the equilibrium constants were in good agreement, except when Cs^+ was one of the cations. Apparently, forces in addition to coulombic and induced dipole forces cause adsorption of Cs^+ to the clay. (Auth)

<1172>

Shalaeva, T.V., and A.T. Miller, Accumulation of Radioactive Strontium 90 by Meadow Plants Under Conditions of Latvia Depending on Soil Humus Content and pH. 1970. Latv. PSR Zinat. Akad. Vestis, 5, 20-23 (Institute of Biology, Riga, USSR)

The main factor influencing absorption of radioactive strontium 90 by meadow and pasture plants under climatic and soil conditions of Latvia is the amount of humus substances in soil. The role of soil acidity is less markedly pronounced. The largest amounts of radioactive strontium were found in the following plants: *TRIFOLIUM FRATENSE* L., *PHLEUM PRATENSE* L., *PESTUCA RUBRA* L., *CAREX INFLATA*, Huds., the smallest in *SESLERIA COERULEA* (L.), Ard., *CAREX NIGRA* (L.) Reichard. The established regularities concerning specific peculiarities of meadow vegetation as regards accumulation of strontium 90 remain unchanged under differing soil conditions. (Auth)

<1173>

Shalaeva, T.V., and G.S. Sabardina, Radioecological Characteristics of the Main Components of Vegetation Cover of the Latvian SSR Meadows and Pastures. 1971. Latv. PSR Zinat. Akad. Vestis, 11, 41-46 (Institute of Biology, Riga, Latvia, USSR)

Strontium 90 and Cs 137 accumulations were recorded for basic grassland species in Latvia in 1964, 1965, and 1967. Soil humidity increased accumulation of both radionuclides, especially Cs 137. Organic matter and certain pH conditions favored Sr 90 accumulation. Legumes (*TRIFOLIUM PRATENSE*) accumulated Sr 90 more than other grassland species. It is

suggested that accumulation of these radionuclides can be predicted if ecological data are available. (ST)

<1174>

Shalhevet, J., Effect of Mineral Type and Soil Moisture Content on Plant Uptake of Cesium 137. 1973. Radiation Botany, 13, 165-171 (National and University Institute of Agriculture, Rehovot, Israel)

The effect of moisture content on Cs 137 uptake by plant roots may be controlled by two main soil factors, ion diffusion and ion concentration. In an experiment employing a split root technique, where a constant moisture content was maintained, uptake was diffusion-controlled and therefore reduced as moisture content decreased. When moisture was allowed to fluctuate in a drying and wetting cycle, uptake was concentration controlled: the drier the soil, the higher the uptake. Fixing Cs 137 interlayer spaces of vermiculite by K treatment or fixing Cs 137 on edge fixation sites in illite, resulted in a drastic reduction in uptake. In these systems, whatever uptake there was came from sources of soluble Cs 137 that were present in small concentrations. (Auth)

<1175>

Shalhevet, J., and B. Yaron, Ion Distribution, Moisture Content, and Density of Soil Columns Measured with Gamma Radiation. 1967. Soil Science Society of America Proceedings, 31, 153-156 (Volcani Institute of Agricultural Research, Rehovot, Israel)

Anion distribution in soil columns was measured nondestructively by using a radioactive tracer, Co 60 labeled Co(CN). The breakthrough curves of Cl and Co(CN) were very similar, indicating the possible use of the Co 60 complex ion as a qualitative model for anion movement. The external measurement of gamma activity was compared to measurements of 1:1 water extracts of the sectioned columns. The gamma activity of the tracer was measured along uniformly packed soil columns through a few drying and waiting cycles. Drying was done with a stream of warmed air that passed around and through the perforated soil columns. Moisture content and density of the soil in the columns were measured simultaneously by the gamma attenuation method. An equation, the parameters of which were determined empirically, giving density as a linear function of moisture content, may be introduced into the attenuation equation to correct for the variation of density with moisture content. (Auth)

<1176>

Shchebetkovskii, V.N., Investigation of the Sorption from Aqueous Solution of Cesium 137, Strontium 90, and Yttrium 91 by Synthetic Zeolites of the X Type in Sodium Form. 1968. Radiokhimiya, 10, 151-156

The dependence of the sorption of Cs 137, Sr 90, and Y 91 by X-type zeolites in the sodium form was studied as a function of the content of sodium chloride and humus material in the solution. The sorption of Cs 137 and Sr 90 by NaX zeolite did not depend on the presence of humus material in the solution and increased linearly with decrease of the NaCl concentration in the limits from 0.5 to 10 (E-3) M, and in the case of Cs the absence of the effect of a change in the solution pH was noticeable in the regularity of the ion exchange of Na on Cs. The effects of the

<1176> CONT.

presence of humus materials in the solution on the sorption of Y91 by NaX zeolite were found as a result of the formation of associations of Y with this material. (tr-Auth)

<1177>

Shchebetkovskii, V.N., and A.G. Khoroshailov, Investigation of the Behavior of Radioactive Elements in Sorption Systems with Humus Substances. II. Sorption of Yttrium 91 by Activated Charcoal from Aqueous Solutions in the Presence of Humic Acids. 1970. Radiokhimiya, 12, 442-447

As a result of an investigation of the sorption of Y 91 by iodide charcoal as a function of the Na₂SO₄ concentration at various pH values of the solutions, ion exchange and the colloidal character of the absorption of the radioactive isotope by the sorbent were investigated. An influence of humic acids on the magnitude and nature of yttrium sorption by charcoal was detected. In the presence of humic acids, a non-ion-exchange (colloidal) character of the sorption of Y 91 by the sorbents predominates. As a result of an investigation of the sorption of humic acids by charcoal, empirical functions were obtained, which relate the values of the sorption to the sodium sulfate concentration in solution, and an explanation was cited for the principles of sorption on the basis of a consideration of the nature and state of humus in solution. Some considerations on the existence of associates of Y 91 with micelles of humic acids were expressed on the basis of the change in the nature of the absorption of Y 91 by charcoal in the presence of these substances. (Auth)

<1178>

Shchebetkovskii, V.N., and Yu.V. Kuznetsov, Behavior of Cesium 137 and Cerium 144 in the Sorption System Seawater-Sediment. 1971. Soviet Radiochemistry, 13, 911-913 (Not given)

The behavior of Cs 137 and Ce 144 in the sorption system seawater-sediment was investigated in the presence of variation of the specific content of the sorbent. The sorption of Cs 137 obeys Henry's Law, which is evidence of homogeneity of the sorbate. The sorption behavior of Ce 144 reflects the presence of this microcomponent in the form of several forms with different affinities for the sorbent; at least one type of particle is not absorbed by sea sediments. (Auth)

<1179>

Shchebetkovskii, V.N., Yu.P. Tarlakov, and Yu.M. Egorov, Behavior of Radioactive Elements in Sorption Systems with Humus Substances. III. Sorption of Cesium 137 from Aqueous Solutions with Activated Charcoal in the Presence of Humic Acids. 1972. Soviet Radiochemistry, 14, 654-655 (Not given)

The presence of humic acids in solutions, reducing the sorption of Cs 137 by activated charcoal, does not change the ion exchange nature of the absorption of the sorbate by the sorbent. The results of an investigation of the behavior of Cs 137 in sorption systems containing charcoal and the anion exchange resin IA-1 demonstrates the absence of interaction between cesium and humic acid in the solutions. (Auth)

<1180>

Sherman, W.C., and D.C. Banks, Seepage

Characteristics of Explosively Produced Craters in Soil and Rock. 1970, August. MCG-TR-27; 75 p. (Army Engineer Waterways Experiment Station, Vicksburg, MS)

A review is presented of the permeability characteristics of soil and rock formations in both disturbed and undisturbed conditions which are likely to occur in the zones surrounding craters. Methods for determining permeability are discussed, and typical values of permeability in a variety of materials are tabulated. Factors which affect the seepage characteristics of craters are discussed, and a few examples are presented to illustrate the influence of seepage on stability calculations. The data indicate that laminar-flow conditions will prevail in soil and rock formations, dependent upon the size of the pore opening and hydraulic gradient. For a given pore opening, a critical gradient exists above which the flow is found to be turbulent; the technique of constructing flow nets for turbulent flow is illustrated. The correct assessment of seepage conditions in the zones surrounding a crater will depend to a large extent upon the correct evaluation of boundary conditions, such as geological discontinuities and sources of seepage. (Auth)

<1181>

Shiraishi, Y., and R. Ichikawa, Fallout Strontium 90 in Beer. 1970, September. Health Physics, 19, 443-444 (National Institute of Radiological Sciences, Chiba, Japan)

The fallout Sr 90 content in Japanese beer was determined in order to compare its annual change with that of Cs 137 which depended on the deposition rate of atmospheric Cs 137 due primarily to nuclear weapon tests. The concentration of Sr 90 and Cs 137 in beer and the monthly deposition of Sr 90 in the Tokyo area from 1959 to 1969 was shown graphically. The results indicated that the accumulation of Sr 90 in the soil was more easily absorbed by plant roots than Cs 137. A table giving the Sr 90 and Ca content in raw materials, spent residues, and 1 liter of beer in 1967 is presented and discussed. The balance of Sr 90 and Ca between the raw and spent materials both comprising malt, side materials, and hops, was in good agreement with the values measured in beer. 60 percent to 70 percent of both Sr 90 and Ca was transferred from raw materials to beer during the manufacturing process. (Auth)

<1182>

Shiraishi, Y., and H. Okabayashi, Radioactive Contamination of Fruit Trees by Fission Products. I. Distribution of Fallout Cesium 137 in the Orchard in 1965. 1967, September. Soil Science Plant Nutr., 38, 333-338 (National Institute of Radiological Sciences, Chiba, Japan)

The Cs 137 concentration at various soil depths was investigated in 1965 in the (tangerine) orchard volcanic-ash soil, Kanagawa Prefecture. The Cs 137 concentrations per unit volume in the orchard soil were of an exponential nature at a depth of 0 to 30 cm. Particular mobility factors existed in the clear tilled, the dry-leaf scattered and the grass grounds, and the trodden (orchard) path. Furthermore, in the orchard grounds there was a single mobility factor, while there were two different mobility factors in the path. By means of the mobility factor, studies were made on the mobility-factor values for general soils, the Cs 137 concentrations near the ground surface, the total cumulative amounts, the concentration distribution at depths, and

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so on. (NSA)

<1183>

Shirshova, R.A., Accumulation of Cesium 137 in Plant Crops as a Function of the Properties of the Soil. 1964. *Agrokhiimiya*, 3, 88-95 (Soil Institute, Moscow, USSR)

Greenhouse experiments were conducted with buckwheat plants, grown on soils of various genetic types, characterized by different contents of exchange potassium (0.03-1.08 mg-equiv per 100 grams of soil). The entry of Cesium 137 into the plant from the soil and its accumulation in the crop was found to be determined to a substantial degree by the content of exchange potassium in the soil. With increasing content of exchange potassium, the absorption of radiocesium by the plants was substantially reduced. The accumulation of Cesium 137 in the crop occurred to a considerably lesser extent than that of Strontium 90. When the plants were grown on soils with low contents of potassium accessible for the plants, the amount of Cesium 137 absorbed by the plants was considerable, rendering such products unsuitable for use. Supplementary applications of potassium fertilizers (in the form of phosphates and sulfates) on such soils reduced the penetration of Cesium 137 into the plants by 10-fold or more in comparison with its content in plants grown on soils without the addition of potassium. The greatest effect of reduced absorption of radiocesium by plants was observed when both lime and potassium were applied on acid soils; the accumulation of Cesium 137 in the crop decreased more than 20-fold in this case. (NSA)

<1184>

Shirshova, R.A., Effect of Potassium Fertilizers on the Uptake of Radioactive Strontium by Plants. 1962. *Soviet Soil Science*, 3, 263-269 (Dokuchayev Soil Institute, USSR)

The results of the investigations revealed the addition of potassium fertilizers to the soil, as well as the addition of lime, can serve as one method of reducing the uptake of radioactive strontium by plants from the soil and its accumulation in the harvest. (Auth)

<1185>

Shone, M.G.T., Studies on Methods for Assessing the Availability of Cesium in the Soil. 1964. *ARCRI-12*: (p. 47-49) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

An upper Greensand soil freshly contaminated with tracer quantities of Cs 137 was extracted with various dilute solutions to determine the availability of Cs in the soil. Cesium chloride removed a much greater percentage of the Cs 137 than the other electrolytes and the process appeared to be complete in one hour. Most of the other solutions displaced considerably more Cs 137 after three days than after one hour. This observation is consistent with a release by exchange of some Cs 137 from internal surfaces of the clay lattices due to deflocculation. (ST)

<1186>

Short, Z.F., R.F. Palumbo, P.R. Olson, and J.R. Donaldson, Uptake of Iodine 131 by the Biota of Fern Lake, Washington, in a Laboratory and a Field Experiment. 1969, Autumn. *Ecology*, 50,

979-989 (University of Washington, Seattle, WA)

The distribution of I 131 among the biota of Fern Lake, Washington, was compared in aquarium and field experiments. The samples for study in the laboratory were isolated in containers so that the water solution, and not food, was the major source of the radionuclide. The field experiment related the uptake of I 131 by organisms isolated in containers to the accumulation by those with access to their usual sources of food. The organisms included *NITELLA FLEXIS*, crayfish, mussels, trout, and an amphipod. In the aquarium, the initial concentration of I 131 was 8,000 times the average concentration calculated for the lake experiment. Maximum concentration factors ranged from 1.7 and 2.6 for the muscle of trout and crayfish, respectively, to 280 for the thyroid of trout, 380 for *NITELLA FLEXILLIS* and 600 for an amphipod, *GAMMARUS* sp. Iodine 131 was not detected in a number of samples collected from the lake, but accumulation factors were as high as 1,400 for *Nitella* clumps and 12,000 for the thyroid of trout. Young microcrustaceans, which are able to accumulate iodine directly from water, were an important source of I 131 for trout. (Auth)

<1187>

Shushova, R.A., Effect of Potassium and Calcium Compounds on Accumulation of Cesium 137 in Oat Crop. 1969. *Agrokhiimiya*, 5, 100-105

The addition of potassium fertilizers strongly reduced the uptake of radiocesium in plants grown on an acid turf-podzolic soil. Amendments of calcium appeared to be affected by uptake of radiocesium. (CWF)

<1188>

Shvedov, V.P., and V.K. Vinogradova, The Content, Distribution, and Migration of Long-Lived Fission Products in Soils. Section 1. Distribution and Migration of Fission Products. *AEC-tr-6049*; (p. 225-232)

One of the basic links in the movement of fission products into the food chain is the soil. The sorption of radioactive products in soils depends on the chemical structure of the soil, its ion exchange capacity, the presence in the soil of ions close in chemical properties to the radioisotopes, the pH of the soil, and the movement of ground waters in the soil. Results are summarized from a number of studies on movement of Sr 90 through soils. Data are included from measurements of the content of Sr 90 in soil samples collected from 1956 to 1961 at various locations throughout the world. (Auth)

<1189>

Shvydko, M.S., D.K. Popov, A.A. Borichev, and O.A. Mikhailova, Methods of Determination of Cesium 137 in Objects of the External Environment. 1971. *Radiokhiimiya*, 13, 97-102

A survey of the methods of determination of cesium 137 in objects of the external environment is cited. A method is suggested for the determination of cesium 137, providing for a combination of potassium-cobalt ferrocyanide concentration of cesium 137 with gamma spectrometry or a measurement of the beta activity of the adsorbent. (Auth)

<1190>

Sidrak, G.H., L.J. Middleton, P. Newbould, and H.M. Squire, Effect of Nutrient Supply on the

<1190> CONT.

Discrimination between Strontium and Calcium in Plants. 1964. ARCRL-12; (p. 64-65) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Results of experiments in which barley and pea seedlings were grown in nutrient solutions containing different concentrations of Sr 85 and Ca 45 showed that wide variations in the ratio of strontium to calcium and in the absolute concentrations in which they are present in the culture solution had little effect on discrimination between the two ions in their transfer to shoots. Retention in roots, however, appeared to be affected. (ST)

<1191>

Sigler, W.F., Effects of Uranium Mill Wastes on Stream Biota. 1966. Agr. Exp. Sta., Bull., 462, 76 (Utah State University, Salt Lake City, UT)

Waste waters from uranium mills contain radioactive substances. In the Animas river the radium activity was found to be 5 to 9 times above background in the water and up to 25 times the background level in the bottom deposits. Tissues of fish collected from the river contained 10 to 15 times the background levels of radium 226. Studies in the summer of 1958 showed complete absence of bottom fauna below the mill, and this pollution effect extended for 50 miles downstream. The amount of radium in the water and in the biota of the San Miguel and Dolores rivers was even higher than in the Animas river. It is stressed that waste waters from uranium mills should receive adequate treatment before discharge to prevent such pollution. (Auth)

<1192>

Sill, C.W., and R.L. Williams, Radiochemical Determination of Uranium and the Transuranium Elements in Process Solutions and Environmental Samples. 1969. Anal. Chem., 41, 1624-1632 (Idaho Operations Office, Health Services Laboratory, Idaho Falls, ID)

A previous procedure for the separation and determination of uranium and the transuranium elements using barium sulfate has been improved greatly and applied to practical problems. By adding a more dilute barium solution dropwise to the sample solution at its boiling point, precipitation of the elements being carried was increased to a remarkable 99.995%, or a decontamination factor of $2 \times 10^{(5+4)}$ in a single precipitation. Ten pure solutions taken through the entire procedure including fusion, separation, and determination gave a relative standard deviation of 0.9%. The same changes also increased the permissible level of the worst interfering elements to about 1 mc with most of the elements in the periodic table having been tested. The procedure was applied to many kinds of process solutions and environmental samples with excellent sensitivity, precision, and reliability. The radiochemical purity of all fractions is demonstrated by high-resolution alpha spectrometry. In addition, a procedure for the precise determination of gross alpha activity is presented and its use in complying with the summation rule for mixtures required by federal regulations is demonstrated. (Auth)

<1193>

Skadchenko, N.M., Effect of Various Forms of Stable Strontium Compounds on the Uptake of Strontium 90 into Plants as Related to the Phosphorus and Calcium Nutrition Conditions,

1968. Vestn. Mosk. Univ., Biol. Pochvoved., 23(4), 106-109

Higher concentrations of stable strontium in soils tends to increase the uptake of strontium 90 in plants. Stems appeared to accumulate radiostrontium more intensively than leaves. The reduction in plant uptake of radiostrontium by lime and soluble phosphorus amendments was decreased proportional to the increasing stable strontium content of soil. Nitrate forms of stable strontium applications were not as effective in this respect as chloride forms. (CWF)

<1194>

Skadchenko, N.M., On the Effects of Potassium Phosphate and Lime on the Accumulation of Strontium 90 by Plants Depending on the Stable Strontium Content in the Soil. 1964. JPRS-27940; (p. 10-17) (Moscow University, Moscow, USSR)

The effects of various doses of stable Sr, phosphate and lime on the accumulation of Sr in the vegetative parts and grain of oats were studied. Results showed that the addition of stable Sr to the soil caused an increase in Sr 90 in oat plants, especially in the stalks; the addition of K₃P₀₄ to the soil decreased the deposition of Sr 90 in both vegetative plant parts and grains and the greatest reduction of Sr 90 in grain and vegetative plant parts was produced by the addition of lime to the soil. (NSA)

<1195>

Skadchenko, N.M., The Effect of Potassium Phosphate and Calcium Hydroxide on the Accumulation of Strontium 90 in Plants and Its Dependence on the Stable Strontium Content of the Soil. 1964. Pochvovedenie, 5, 57-62 (Institute of Biophysics, Moscow, USSR)

As a result of radioactive fallout, long half-life radioactive isotopes, among which Sr 90 is potentially the most dangerous one, are introduced into the human organism, mostly by the intermediary of agricultural products. The accumulation of these radioisotopes was investigated in tests carried out in podzolic soils, attempting to determine the effect of Ca(OH)₂ and K₃P₀₄ additions to the soil on the Sr 90 content of oats as a function of the stable Sr content of the soil. The results indicate that if no stable Sr is added to the soil, the addition of large amounts of potassium phosphate reduces markedly the amount of Sr 90 introduced into the plant; liming exerted an even stronger inhibiting effect on the accumulation of Sr 90. The presence of increasing amounts of stable Sr in the soil resulted in an increase of Sr 90 in the grains and leaves. (NSA) (CWF)

<1196>

Smith, K.A., The Comparative Uptake and Translocation by Plants of Calcium, Strontium, Barium and Radium. 1971. Plant and Soil, 34, 643-651 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Measurements were made of the concentrations of calcium, strontium, barium, Ra 226 and Ra 228 in ammonium acetate extracts of soil and wheat plant tissues from three sites. The ratios of strontium to calcium in the plants, relative to those in the soil extracts, varied little between soils, in contrast to the ratios of barium and radium to calcium. The ratios of barium to radium showed a similar

<1196> CONT.

consistency to those of strontium to calcium. Significant differences were observed in the availabilities of the two radium isotopes. Strontium, barium and radium were less mobile than calcium in the plant; barium and radium showed marked retention in the stems. No discrimination occurred between these two ions in the plants. (Auth)

<1197>

Smith, K.A., and P.G. Watson, Radium 226 in Diet in the United Kingdom in 1963, 1964. ABCRL-12; (p. 79-80) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Results of measurements of concentrations of Ra 226 in foodstuffs in the United Kingdom in 1963 are given in tabular form. The levels of Ra 226 were generally similar to those in previous years. Milk content showed seasonal variations with values increasing in late summer. The estimated daily Ra 226 content of the average diet was about 1 pCi. (ST)

<1198>

Smith, L.H., D.C. Rasmussen, and W.M. Myers, Influence of Genotype upon Relationship of Strontium 89 to Calcium in Grain of Barley and Wheat. 1963. Crop Science, 3, 386-389 (University of Minnesota, Department of Agronomy and Plant Genetics, St. Paul, MN)

In barley, statistically significant differences in Sr 89 and Ca contents and ratio of Sr 89/Ca were observed among 20 varieties. These differences were relatively reproducible between two experiments conducted under different environmental conditions. Significant varietal differences with respect to Sr 89 and Ca contents, and Sr 89/Ca ratio and the consistency of the differences under different environmental conditions suggest genetic control of these factors. Discrimination against Sr 89 accumulations by some varieties is suggested by varieties containing relatively high levels of Ca and low levels of Sr 89. In wheat, significant varietal differences were observed for Sr 89 and Ca contents and Sr 89/Ca ratio. The data for Sr 89 accumulation was found to be reproducible over the two experiments, whereas the data for Ca were not. The relationship of Sr 89 to Ca, as indicated by Sr 89/Ca ratios is relatively consistent over the two experiments. These data suggest a major influence of plant genotype upon Sr 89 accumulation and ratio of Sr 89/Ca in the grain of some wheat varieties. (Auth)

<1199>

Smith, P.F., G.K. Rasmussen, and G. Hrnaiar, Leaching Studies with Metal Sulfates in Light Sandy Citrus Soil in Florida. 1962. Soil Science, 94, 235-238 (U.S. Horticultural Station, Orlando, FL)

Columns of topsoil and subsoil of Lakeland fine sand were leached to determine the mobility of Cu, Zn, and Mn under both high- and low-acid conditions. Cu, Zn, and Mn were added as sulfate solutions. Thirty fractions of water were run through the columns during a 10-week period. Both pH and organic matter content affected metal mobility. The topsoil was much more retentive than the subsoil, and at the same pH the difference was about four-fold. The order of mobility was the same in all cases tested and was $Mn > Zn > Cu$, with Zn about halfway between Cu and Mn. The relatively weak retention of metals by the

organic-free subsoil offers an explanation of the heavy loss when surface-applied metals are plowed under. (Auth)

<1200>

Smith, S.J., and A.D. Scott, Extractable Potassium in Grundite Illite. I. Method of Extraction. 1966. Soil Science, 102, 115-122 (Iowa State University, Agricultural and Home Economics Experiment Station, Ames, IA)

Samples of <2u Grundite illite were placed in solutions that contained NaTPB, and the amounts of K replaced by Na in different periods of time were determined. By varying the Na and TPB concentration in the extracting solution, the rate of K removal was increased. Changes in the solution pH from neutrality, the use of replacing cations other than Na, and modifications in the method of separating the precipitated K did not enhance the extraction of K. Thus, a 1.7 M NaCl-0.3 M NaTPB-0.01 M EDTA solution was adopted as the most effective extracting solution. With this solution, 81.5 me. K per 100g (66 per cent of the total) was extracted in one week. However, contract periods of more than a year did not remove more of the K. It has been concluded that only a portion of the K in Grundite illite is exchangeable with Na and that this limited exchange is due to an inherent characteristic of the sample rather than to the extracting solution. Also, by comparing these results with previous observations that almost all the K in muscovite is extractable, it has been suggested that materials other than K mica are responsible for the limited extraction of K observed with Grundite illite. (Auth)

<1201>

Sobolev, I.A., and L.M. Khomchik, Experimental Burial of Radioactive Wastes of Low Activity Level in Clay Soils at Moscow Station. 1967. JPRS-42565; CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Waste into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 1-11)

The burial of low-level radioactive wastes in clay soils near the Moscow Radioactive Waste Disposal Station was investigated. The soil was analyzed for geological make-up and for adsorption properties. The composition of the wastes was determined. Experimental burials were made and their effects tested after one year. It was determined that the clay soils of this area have a rather high capacity for adsorption of Cs 137 and Sr 90, that this adsorption occurs during the process of infiltration through the soil, and that the rate of movement of activity into the soils for both liquid and cemented solid wastes amounts to between 0.2 and 1.0 meters per year. The soil at this burial site was concluded to be unusable for the burial of radioactive wastes. (NSA)

<1202>

Soileau, J.M., Activity of Barley Seedling Roots as Measured by Strontium Uptake. 1973. Agronomy Journal, 65, 625-628 (National Fertilizers Development Center, Soils and Fertilizers Research Branch, Muscle Shoals, AL)

Root activity at various depths in soils is important in relation to effective use of lime and fertilizers by crops. Barley (HORDEUM VULGARE L.) seedlings were grown in presplit cylinders in the greenhouse to measure root activity in 3 10-cm soil depth zones and to

<1202> CONT.

estimate daily rates of nutrient uptake. Twenty-five seedlings were planted per 15 x 30 cm cylinder containing 6.5 kg of soil. SrCO₃ was applied to 1 of the 10-cm layers of soil, and the plants were sequentially harvested for measurement of Sr uptake and root growth. A substantial number of roots penetrated to the 20-30 cm zone in 14 days. After 31 days, total root length was 662 m, distributed uniformly throughout the soil column. Root activity index calculations based on Sr uptake in tops per unit length of roots indicated that the 0-10 cm layer was the most active root zone over a 31-day period. Total uptake of Sr, Ca, Mg and P by barley tops increased linearly with increase in total root length or dry weight. Mean daily rates of uptake of Ca, Mg and P (μg/m of roots/day) showed a general decrease with time. Milliequivalent concentration ratios of Ca to Sr in barley tops were much lower than ratios of exchangeable Ca to exchangeable Sr in the soil. (Auth)

<1203>

Solovov, A.V., E.A. Andreyeva, K.E. Ginzburg, M.K. Mel'nikova, Yu.A. Polyakov, V.M. Prokhorov, D.V. Fedorovsky, and R.A. Shirshova, Use of Radioactive and Stable Isotopes in Agrochemical Investigations. 1971. CONF-710901; Part of Proceedings of the Fourth International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 6-16, 1971 (Lenin All-Union Academy of Agricultural Sciences, USSR)

A review concerning the uses of radioactive isotopes in recent Russian agrochemical research is given. (CWF)

<1204>

Sommermeier, K., and K.J. Godt, The Uptake of Radioactivity Directly Through Leaves and Indirectly Via the Roots of Plants. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 500-502), 624p. (University of Freiburg, Institute of Radiology, Freiburg, German Federal Republic)

The contamination of plant tissue with radioactive fission products was determined to be largely through wet fallout. Plants at high altitude subject to greater wet fallout contained larger concentration of radioactivity. (CWF)

<1205>

Spencer, H., L. Kramer, J. Sawachson, E.P. Hardy, Jr., and J. Rivera, Strontium 90 - Calcium Interrelationships in Man. 1973. Health Physics, 24, 525-533 (Health and Safety Laboratories, New York Operations Office, NY; Veterans Administration Hospital, Metabolic Section, Hines, IL)

Strontium 90-calcium interrelationships have been studied by determining Sr 90 and calcium balances in man during the intake of different dietary levels of Sr 90 and of calcium. On a calcium intake of about 1 g/day, given as milk, the urinary Sr 90/Ca ratio was about the same as the dietary Sr 90/Ca ratio and therefore the observed ratio urine/diet was about 1, while on low calcium intake and on supplementing the diet with calcium as the gluconate the urinary Sr 90/Ca ratio differed considerably from the Sr 90/Ca ratio of the diet and the observed ratio urine/diet was variable. The observed ratio stool/diet was

about 1 on all calcium intake levels. Stable calcium did not significantly decrease the net absorption of Sr 90, $P < 0.1$. (Auth)

<1206>

Spencer, W.F., and J.E. Giesekeing, Cobalt Adsorption and Release in Cation Exchange Systems. 1954. Soil Science, 78, 267-276 (University of Illinois, Department of Agronomy, Urbana, IL)

Cationic exchange reactions of cobalt were studied with cobalt adsorbed on Amberlite IR-100, Wyoming bentonite, and Swygart clay. The results indicate that cobalt is adsorbed on the exchangers more strongly than is calcium. Accordingly, the exchangeability of soil-adsorbed cobalt in field soils - hence, the proportion of cobalt available to plants - should decrease as the amount of adsorbed cobalt becomes less. The relative amounts of cobalt adsorbed, calcium released, and H ions formed in the reactions indicate that Co (+2) is adsorbed on the exchangers as the monovalent hydroxy-cobaltous ion and as the divalent cobaltous ion. The H-ion concentration of the reaction medium presumably determines which ion predominates on the exchanger. (Auth)

<1207>

Spitsyn, V.I., and V.D. Balukova, Investigation of Sorption and Migration of Radioactive Isotopes in Soils and Rocks of Various Compositions. 1967. JPRS-42565; CONF-670512; STL/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 12-22)

The use of soils for the natural purification of liquid radioactive wastes was investigated. Laboratory tests were performed to study the distribution, migration, and sorption of radioisotopes from liquids filtered through various types of soils. Field experiments were conducted to determine the migration of Strontium 90 from solutions dumped into upper soil layers located over water bearing strata. It was concluded that dumping liquid radioactive wastes into such soils is a public health hazard, that the most even distribution of radioisotopes with the least amount of contaminated soil occurs in porous water bearing horizons, and that use of such horizons for waste disposal requires low rate of movement of the stratal water, reliable waterproofing of horizon top and bottom, and a soil area of no economic value. (NSA)

<1208>

Spitsyn, V.I., V.D. Balukova, and T.A. Ermanova, Studies of Sorption and Migration of Radioactive Elements in Soils. 1963. Part of Proceedings of a Symposium on Treatment and Storage of High-Level Radioactive Wastes held in Vienna, Austria, October 8-12, 1962, (p. 569-577), 663p. (International Atomic Energy Agency, Vienna, Austria)

The results are presented of investigations into the sorption and migration of radioelements during radioactive filtering flow through the soil. The types of sand, of average coarseness and effective porosity, which are to be found widely disseminated throughout the central belt of the Soviet Union were used. It is shown that the sorption of strontium and cesium take place separately and that the capture of cesium by soils is an irreversible process. It is also shown that sorption processes inhibit the

<1208> CONT.

filter-diffusion process at low diffusion rates and that the strontium movement is 40 to 60 times slower than the filtering and the cesium movement 100 times slower. Trials were made with a method of calculating the basic kinetic parameters of sorption, thus making it possible to characterize the movement of radioactive strontium and describe the migration of radioactive cesium. (NSA)

<1209>

Spitsyn, V.I., V.D. Balukova, A.F. Naumova, V.V. Gromov, F.M. Spiridonov, E.M. Vetrov, and G.I. Grafov, A Study of the Migration of Radioelements in Soils. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 1-13, 1958, Volume 18, (p. 439-499), 624 p. (USSR Academy of Sciences, Institute of Physical Chemistry, USSR)

A study is presented of the laws governing the sorption of uranium fission products by some natural sorbents, such as soils and soil forming minerals, and from solutions with a varying salt content. Particular attention is paid to strontium 90 as the most dangerous isotope from the physiological standpoint. Laboratory tests proved that the sorption of all the known radioelements, with the exception of radiozirconium, radioiodine and radiocesium, is much more complete from alkaline solutions than from acidic. The pH of the medium had a particularly strong effect on the sorption of cerium. Up to 98 to 100 percent of cerium was absorbed from an alkaline solution containing sodium nitrate, regardless of the initial concentration or the quantity or nature of the soil. As for acidic media, from solutions containing aluminum, cerium was practically not absorbed at all. The degree of sorption of radioruthenium was extremely low, but in an alkaline solution it may reach several tenths of a millicurie per 100 g of soils when cationic ruthenium is used. Practically no ruthenium was absorbed from an acidic medium. Anionic ruthenium was absolutely not absorbed by soils. The sorption of strontium in an acidic medium was several times lower than in an alkaline medium. When an alkaline solution with a strontium concentration of $5.32 \cdot 10^{-3}$ m-equiv/l was used, the soils, regardless of their nature, absorbed roughly 60 percent of the strontium. Under similar conditions only 5 to 6 percent of the input quantity was absorbed from an acidic aluminum solution. Apart from this, a great number of natural sorbents, mainly pure minerals of inorganic origin, making up the earths and soils were tested to determine to what degree they absorb microquantities of strontium. (Auth)

<1210>

Spitsyn, V.I., and L.L. Grinberg, Investigation of the Sorption of Radioruthenium by Certain Minerals. 1971. Soviet Radiochemistry, 13, 823-827 (Not given)

The sorption of radioruthenium by natural sorbents was investigated. Tests of 56 samples established that carbonate minerals and individual representatives of other mineral classes (homatite, pyrolusite) showed high values of sorption with respect to solutions in which ruthenium was present in the form of positively charged particles. It was found by methods of ion exchange and electrodialysis that positively charged particles predominate in solutions of pure compounds of radioruthenium (nitrate and nitrosenitrate). A solution of ruthenium

malate consists primarily of anionic complexes. The sorption of radioruthenium is due to interaction of the negatively charged surface of the sorbent with the positive particles of radioruthenium in solution. (Auth)

<1211>

Spitsyn, V.I., and V.V. Gromov, A Study of the Systematic Adsorption of Radioactive Strontium by Montmorillonite and Its Fixation by Roasting. Soviet Journal of Atomic Energy, 5, 1341-1347 (Institute of Physical Chemistry, Academy of Sciences, Moscow, USSR)

The conditions of adsorbing Sr 89, Sr 90 by montmorillonite have been studied in detail. Various cations may be arranged in the following order according to their capacity to lower the adsorption of radioactive strontium: $Al^{(+3)} > Fe^{(+3)}$ and $Ba^{(+2)} > Ca^{(+2)} > Mg^{(+2)} > H^{(+1)} > NH_4^{(+1)} > K^{(+1)} > Na^{(+1)}$. It has been shown that the adsorption of radioactive strontium by montmorillonite is an ionic exchange process and obeys the law of mass action. The presence of the anions $CO_3^{(-2)}$, $SO_4^{(-2)}$, and $C_2O_4^{(-2)}$ in a solution, which form relatively insoluble salts with strontium, does not change the mechanism of the adsorption, but decreases the quantity of radioactive strontium adsorbed, apparently by forming radioactive colloids. The process of fixing radioactive strontium on montmorillonitic clays during roasting has been studied. Roasting at temperatures above 850-900 degrees and extending the roasting time over 1-2 hours do not affect the degree of fixation of radioactive strontium. In these experiments, the activity lost by washing in stream and sea water amounted to about 2 percent. It is suggested that, up to the beginning of alteration in the crystal lattice ($T=800$ degrees centigrade), the fixation is controlled by the formation of slightly soluble chemical combinations of strontium and the adsorbent. Above 800 degrees centigrade the process is determined by changes in the crystal lattice and by a gradual vitrification of the mineral. (Auth)

<1212>

Spitsyn, V.I., and V.V. Gromov, Adsorption of Radiostrontium by Some Soils and Soil Materials. 1959. Soviet Soil Science, 12, 1410-1414 (Institute of Physical Chemistry, Academy of Sciences, Moscow, USSR)

Adsorption of the radioactive fission product strontium was studied with fifty natural materials frequently found in soils, from solutions containing no extraneous cations and in the presence of stable strontium or calcium ions. The greatest adsorption of radiostrontium was shown by the clay minerals (montmorillonite, kaolinite, halloysite) micas, hydrous micas, peat, pyrolusite, phosphorite, and nepheline syenite. Therefore, when radiostrontium falls on soils, one expects highest contents where these minerals are present, other things being equal. It was established that the ability of natural materials to adsorb radiostrontium strongly depends on a large exchange capacity. The presence of calcium, even as little as 100 mg/l, considerably reduces the adsorption of microquantities of strontium from solution. Radiostrontium, filtering into ground water, migrates easily and may enter man and animal organisms. (Auth)

<1213>

Squire, H.M., Changes with Time in the

<1213> CONT.

Availability of Strontium 90 in Soil. 1960. Nature, 188, 518-519 (Agricultural Research Council, Field Station, Crompton, Berkshire, England; Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Desorption studies of strontium 89 and 90 revealed that radiostrontium availability was slightly decreased after weathering in soil over a 3 1/2 year period. (CNP)

<1214>

Squire, H.M., Further Studies on Physico-Chemical Changes in the Availability to Plants of Strontium 90 in Soil. 1964. ARCRL-12; (p. 45-47) (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

Seven years after superficially contaminating soils in concrete containers with Sr 90 and planting with ryegrass, there was a reduction of 40-50% in the ratio of Sr 90 to Ca in the grass. Experiments showed that Sr 90 in the soils passed into 0.01M calcium chloride solution as readily as freshly added Sr 89. It was concluded that the downward movement of Sr 90 in the soil was mainly responsible for decreased absorption. (ST)

<1215>

Squire, H.M., Long-Term Studies of Strontium 90 in Soils and Pastures. 1966. Radiation Botany, 6, 49-67 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

The movement of Sr 90 in soil and its absorption by ryegrass were studied over a period of 8 years. Carrier-free Sr 90 was added to the surface of nine soils which contrasted in pH, exchangeable calcium, clay and organic matter and which were exposed to natural weather conditions in concrete cylinders. The downward movement of Sr 90 was greatest in soils which contained over 20 m-equiv/100 g exchangeable calcium and least in a clay soil containing 3 m-equiv/100 g; after 6 years the median depth ranged from 5 to 3 cm. The annual addition of fertilizer to the low calcium soil caused an increase of 400 per cent in median depth; there was a slight increase in the medium calcium soils but none in the calcareous soils. In all soils movement was unaffected by cropping with ryegrass. Differences between soils in the relative absorption of Sr 90 and calcium by ryegrass were due mainly to the calcium content of the soils and to the depth to which Sr 90 had penetrated. Physico-chemical changes during the experiment reduced the availability of Sr 90 by less than 10 percent. The Sr 90/Ca ratio in ryegrass bore a curvilinear relationship to the exchangeable Ca content of the soils, but there was a closely linear relationship between the ratio and the fraction of Sr 90 which was displaced from the soils by 0.01 M calcium chloride. This is attributed to the fact that the displacement of Sr 90 by this solution depends on the ratio of the two ions in the soil solution. Over the first 4 years the downward penetration of Sr 90 reduced the Sr 90/Ca ratio by 10 to 15 percent per year; after the fifth year there was little further change. Annual additions of fertilizer to the soil surface altered the Sr 90/Ca ratio in ryegrass by up to 30 percent; in all but the calcareous soil there was initially an increase, due to the displacement of Sr 90 from exchange site; in the latter years this

was counteracted by increased penetration. (Auth)

<1216>

Squire, H.M., and L.J. Middleton, Behavior of Cesium 137 in Soils and Pastures. A Long Term Experiment. 1966. Radiation Botany, 6, 413-423 (Agricultural Research Council, Radiobiological Laboratory, Wantage, Berkshire, England)

The movement of Cs 137 in soil and its absorption by ryegrass have been studied over a period of 6 years and compared with that of Sr 90. Carrier-free nuclides were added to the surface of 4 soils which contrasted in their content of exchangeable cations and clay and exposed to natural weather conditions. The downward movement of Cs 137 was greatest in a calcareous soil which contained over 25 m-equiv./100 g exchangeable cations and least in a soil with a high clay content; after 6 years the median depth ranged from 1 to 3 cm. The corresponding values for Sr 90 were 3 and 5 cm respectively. As with Sr 90 the movement of Cs 137 was unaffected by cropping with ryegrass but unlike Sr 90 the annual additions of fertilizer to all four soils were without effect. During the first 3 years of the experiment the absorption of Cs 137 by ryegrass decreased by factors ranging from 5 to 40 the decrease being greatest from the soil with the highest clay content and least from the most sandy soil. It was thought to be caused by the progressive fixation of Cs 137 on clay minerals. This fixation appeared to be largely complete 3 years after contamination since the Cs 137 content of grass decreased thereafter by only about 10 per cent. The absorption of Cs 137 was also influenced by the concentration of exchangeable potassium in the soils. The Cs 137 content of grass grown on the soil with the lowest exchangeable potassium and the lowest clay content was some 10 times greater than that from the soil with the highest potassium content. From all soils the amount of Cs 137 absorbed was much less than that of Sr 90 and the ratio in which the two nuclides were absorbed decreased with time in the first year the ratio of Cs 137 absorption to that of Sr 90 ranged from 0.04 to 0.2 whilst corresponding values in the fifth year were 0.01 and 0.04 (Auth)

<1217>

Steenberg, K., and G. Semb, Experiments on Plant Uptake of Radiostrontium from Contaminated Soils. Effect of Liming. 1964. Meldinger fra Norges Landbrukskole, 43, 1-11 (Agricultural College of Norway, Isotope Laboratory and State Soil Investigation, Vollebakk, Norway)

The effect of lime on root uptake of radiostrontium (Sr 89) in oat and clover plants has been studied in pot experiments using ten different types of soil varying in texture, humus content, pH, cation exchange capacity, etc. Lime was given as calcium carbonate in amounts depending on the degree of base saturation and the exchange capacity of the soil. Soils with a base saturation less than 50 percent were given lime in three different amounts corresponding to 50, 75 and 100 base saturation. More saturated soils were given calcium carbonate corresponding to 75 and or 100 percent base saturation. For all soil types pots with unlimed soil were included as well. Strontium was applied as carrier-free Sr 89 in an amount of 60 uCi per pot. Liming was found to have a marked reducing effect both on uptake of Sr 89 and on Sr 89/Ca ratio in plant material. The effects increased with increasing amounts of lime but

<1217> CONT.

was of the same degree for all the ten soils examined, when the content of available calcium (i.e. content of exchangeable Ca plus amount of Ca added) was the same. In a peat soil where an iron deficiency was noted, a disagreement from the other soil types was observed probably due to an interaction of phosphorus. A significant correlation was found to exist between the original soil pH values and Sr 89/Ca ratios in the plant material, as well as between the Sr 89/Ca ratios in plants and content of exchangeable calcium in the soil, content of calcium in relation to the exchange capacity, degree of base saturation and the Ca-content of soil in g Ca per pot. (Auth)

<1218>

Stewart, G.L., The Behavior of Tritium in the Soil. 1971. CONF-710809; Part of Moqhissi, A.A. and Carter, H.W. (Eds.), Proceedings of a Symposium on Tritium held in Las Vegas, Nevada, August 30-September 2, 1971, (p. 462-470), 807 p. (University of Massachusetts, Department of Plant and Soil Sciences, Amherst, MA)

Because of the characteristics of the clay-water system, tritium fractionation occurs as tritium in bulk pore water exchanges with water in different physical states and with hydroxyl groups. Both thermodynamic theory and experimental data suggest that tritium fractionation is small as isotopic exchange occurs between the bulk pore water phase and the tenaciously adsorbed water phase. Isotopic exchange occurs between hydrogen in adsorbed water and crystal lattice hydroxyls for all clay minerals and soils studied. A few samples of illite and Davidson clay showed high exchange rates and suggested that considerable tritium fractionation may occur. The conditions and/or factors responsible for this high exchange are not known. Many practical hydrologic investigations will not require that corrections be applied to experimental data for the isotope effect of tritium because other factors associated with water flow are more significant. (Auth)

<1219>

Stewart, J.D., and F.P. Hungate, Effect of Soil Moisture on Uptake and Translocation of Cesium 137, Potassium, Calcium 45, and Strontium 85. 1967. CONF-660405; Part of Aberq, B. and Hungate, F.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, (p. 399-407), 1051 p. (Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA; Royal Veterinary College, Stockholm, Sweden)

By use of various soil moisture systems it was found that Sr 85 and Ca 45 concentrations in bean plants were not significantly influenced by soil moisture. Whereas the concentrations of Cs 137 was increased considerably and K slightly by low moisture treatments, both ions were accumulated more in the stems than leaves under dry treatments. The effect of soil moisture stress on K and Cs 137 content was also determined for individual leaves, petioles and stems when plants were subjected to a single period of drying. As soil dried from 1/3 bar to 15 bar suction, Cs 137 uptake was increased considerably in petioles and stems and slightly in young leaves. Older leaves which were nearly mature when drying began showed no effect from increased moisture stress. Moisture stress had much less effect

on K uptake than on Cs 137, but followed the same general accumulation and translocation pattern both during and upon recovery from stress. (Auth)

<1220>

Stewart, J.W.B., B.V. Friez, and F.M. Lapid, Studies on the Micronutrient Cation Status of Some Philippine Paddy Soils with Special Emphasis on Zinc. 1971. CONF-711213; IAEA/SM-151/49; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971 (Department of Agriculture and Natural Resources, Republic of the Philippines)

Preliminary investigations on micronutrient toxicity and deficiency in Philippine soils are reported. The available, micronutrient-cation content of top soil samples, taken in survey of a typical rice growing area, showed that there was adequate Fe, Mn and Cu for normal growth of rice (ORYZA SATIVA L.) However, Zn levels were low (DTPA extractable Zn levels less than 1.4 ug Zn/g soil). Available Zn levels were related to soil type but this relationship could not be explained on the basis of soil chemical properties. The efficiency of DTPA, HqCl2 and NH4OAc extractants in predicting zinc deficiency in rice was examined in a greenhouse experiment in which both carrier free and labelled Zn solutions were used to provide L and A value measurements of available Zn. The soil extractant values for Zn showed a significant correlation with plant Zn content in the earlier stages of growth (17 days) but 37 days after transplanting the relationship was not significant. A and L values were not related to plant Zn concentration, due in part to the time of application of Zn and to the change in soil Zn occurring at the onset of flooding. In a second experiment in which maize (ZEA MAYS L.) was grown on zinc deficient soils, L value measurements showed the same trends as plant Zn and extractable Zn. In this experiment it was shown that some of the paddy soils, in which maize is grown in the dry season, contain toxic levels of soil Mn. (Auth)

<1221>

Stewart, M.L., Distribution and Movement of Radioactive Nuclides, Both Natural and Artificial, in Soils, Vegetation, and Wildlife. 1970. Ph.D. Thesis; 181 p. (University of Utah, Salt Lake City, UT)

The movement and distribution of artificial Cs 137, natural Ra 228, and natural K 40 were followed through the soil profiles, vegetation, watercourses, and small animals of a forty acre study area. Mechanisms responsible for the differences in radionuclide levels are described. Erosion, irrigation, crop harvesting, flooding, grazing, and physicochemical soil factors were found to influence the movement of nuclides through soil systems. The levels of Cs 137, Ra 228, and K 40 in each centimeter increment of the thirteen 30 centimeter soil profiles are presented and discussed with respect to both vertical and horizontal distribution in the soil profiles of five different fields. The mechanisms responsible for the transport in a small creek are also described. Large amounts of Cs 137 were found to move down a watercourse in ionic form, adsorbed to particulate surfaces and in conjunction with organic matter. Radium 228 and K were transported down the watercourse as either an integral part of the silt physical separates

<1221> CONT.

or adsorbed to the surfaces of these separates. The presence of fresh fallout in the vegetation (Zr 95, Ru 103, and Ru 106) showed that fallout occurred in 1968 and again in 1969. The importance of cropping efficiency in removing Cs 137 from the study area is discussed. Two crops of alfalfa were found to remove more contaminants than one crop of grass hay, even though more vegetation per crop was harvested from the grass hay field. The wide range of variability of Cs 137 levels in vegetation was the result of crop harvesting and grazing intensity. Significant concentrations of Cs 137 were found to accumulate in small animals living in wet habitats, but not in small animals living in dry habitats. Several methods of reducing the levels of Cs 137, which come from the environment to man and his food, are described. (NSA)

<1222>

Stradomskii, V.B., and S.W. Goncharova, Determination of Strontium 90 in Sediment and Soil by Extraction with Tributyl Phosphate. 1966. *Gidrokhim. Mater.*, 41, 28-32 (Not given)

A method for the determination of Sr 90 in the presence of Y 90 by extraction of the Y 90 with tributyl phosphate is given. (SI)

<1223>

Stroganov, A.A., and E.P. Lisachenko, Accumulation of Cesium 137 by Black Sea Hyponeuston. 1969. *Radiobiologiya*, 9, 603-607 (Institute of Biology of the Southern Seas, Sevastopol, USSR; Institute of Radiation Hygiene, Leningrad, USSR)

A pronounced and statistically significant seasonal variation of the coefficients of accumulation and concentration of Cs 137 by Black Sea hyponeuston was established. The maximum coefficients of accumulation (up to 2000) were noted in samples with a large amount of organic detritus and a predominance of planktonhyponeuston. From the equality of the coefficients of stable and radiocesium, it is concluded that a total isotopic exchange is established between them in the hyponeuston. (tr-Auth)

<1224>

Styra, B.L., T.W. Nedveckaitė, and E.E. Sen'ko, New Methods of Measuring Thoron (Radon 220) Exhalation. 1970. June. *J. Geophys. Res.*, 75, 3635-3638 (Academy of Sciences, Lithuanian SSR, Vilnius, USSR)

Two methods of measuring Rn 210 exhalation, by disintegration chamber and by nuclear emulsion, are described. The data on Rn 220 exhalation under various weather conditions and states of ground surface are summarized. The average values range from zero, when the snow surface is covered by ice, to 33×10 (E-16) Ci/cm² sec for dry ground in summer. (Auth)

<1225>

Surganova, N.A., L.V. Gorbushina, A.I. Spiridonov, and V.G. Tyminskii, Extraction and Radiochemical Methods in the Determination of Uranium Isotopes in Ground Waters. 1971. *Geol. Rozved.*, 14(1), 100-105 (Geological Prospecting Institute, Moscow, USSR)

Determination of isotopic ratios of uranium in natural waters is generally accomplished in three steps: concentration of the U with an

adsorbent, removal of the U from the adsorbent, and alpha spectrometric measurement. A number of published methods were tested for efficiency and accuracy, including U adsorption on activated carbon or on iron hydroxide. Since accurate alpha spectrometry depends on a high degree of purification of the U sample, exchange chromatography and extractive methods based on the use of TBP, Complexon III, and ammonium oxalate are discussed as purification techniques. (NSA)

<1226>

Suzuki, H., M. Ito, O. Suzuki, and G. Meshitsuka, Observations of Fallout in Tokyo. II. Determination of Strontium 90 and Cesium 137 in Rainwater, Vegetables and Soils in Miyake-Jima. 1963. Tokyo Metropolitan Isotope Centre, Annual Report, 2, 87-91 (Tokyo Metropolitan Isotope Centre, Tokyo, Japan)

Radioactive contamination of drinking water in Izu islands (Tokyo) is one of the serious problems of environmental contamination due to nuclear explosion experiments. Miyake-Jima is one of the Izu islands, where they use rain water as drinking water. The Sr 90 and Cs 137 contents in rain water were determined in 1960 and 1961 and the results were 2.08 to 7.26 micro-micro-C/l, and 1.47 to 6.30 micro-micro-C/l, respectively. These values were 10 to 100 times higher than those of tap and well water in other places. The Sr 90 and Cs 137 contents in vegetables and soils were also determined for a comparison of locality. The results were 15.2 to 140.2 micro-micro-C Sr 90/kg fresh and 13.4 to 64.7 micro-micro-C Cs 137/kg fresh for vegetables and 5.6 to 41.2 mC Sr 90/km square and 12.8 to 63.8 mC Cs 137/km square for soil. The results showed no significant differences in locality. Radioactive environmental contaminations in Miyake-Jima was observed in drinking water only. (Auth)

<1227>

Syers, J.K., D.L. Hekma, M.L. Jackson, D.L. Dolcater, and R.W. Rex, Mineralogical Composition and Cesium 137 Retention Properties of Continental Aerosolic Dusts. In Manuscript. Soil Science, 24 p. (University of Wisconsin, Madison, WI; University of California, Riverside, CA)

Aerosolic dusts collected from the atmosphere, mud-rains, snow, and ice varied widely in mineralogical composition. Micaceous minerals, quartz, chlorite, and feldspars were the dominant minerals; kaolinite, vermiculite, montmorillonite, amphibole, and talc were present in some of the samples. The free iron oxide content varied between 0.9 and 3.2 percent. In a dust of Australian origin, collected from the Franz Josef glacier in New Zealand, the free iron oxides (1.7 percent) were present as coatings on individual silicate particles and as discrete masses of colloidal material which were removed by treatment with citrate-bicarbonate-dithionite. The quartz content of the dusts varied widely (9 to 32 percent) but the samples which had a common origin contained similar amounts of quartz. Values for oxygen isotope abundance of quartz isolated from the Northern Hemisphere aerosolic dust samples were greater than those for the Southern Hemisphere samples reflecting the metamorphic and igneous nature of the source materials on the Australian continent. Five of the seven aerosolic dusts and a Hawaiian soil contained Cs 137. The specific activity of Cs 137 ranged from 0 pc/g in dusts from a Greenland ice core, a mud-rain

<1227> CONT.

from England, and a pelagic sediment to 264 pc/g in a dust high in micaceous vermiculite obtained from melted ice on the Franz Josef glacier in New Zealand. All of the samples sorbed significant amounts, approximately 30 to 50 percent, of the Cs 137 added in solution (carrier-free) and, moreover, most of this Cs 137 became fixed against replacement with 0.01 M CaCl₂. Approximately 80 percent of the Cs 137 on the FJ-II sample was also fixed against replacement in 0.01 M CaCl₂. The addition of aerosolic dusts containing little weathered minerals to soils, particularly to soils which are strongly weathered and highly leached, is a soil rejuvenating process. Aerosolic dusts, which contain micaceous vermiculite, can scavenge Cs 137 during transport in the troposphere and presumably also Cs 137 added to soil in rainfall following deposition of the dusts as soils or sediments. The Cs 137 is tightly held by the micaceous vermiculite component of the dusts against replacement by Ca. (Auth)

<1228>

Szabo, A., I. Treiber, J. Balint, E. Jakab, and V. Cordis, Study on the Radioactive Characteristics of Some Leached Chernozems from the Socialist Republic of Rumania. 1968. IPA-IS-49; 18p. (Institute for Atomic Physics, Section V Cluj, Bucharest, Romania)

Radiological analyses were made on eight leached chernozem from different pedogeographical regions of the Socialist Republic of Rumania. It was established that the total beta radioactivity alters between restricted limits, presenting a slight decrease towards the inferior horizons. Correlations between the total radioactivity and the value of pH and T of the samples, respectively, with the contents of TiO₂ and ZrO₂, are presented in graphical form. In order to clarify the interdependence between the relation, Ra/Th and total radioactivity were analyzed radiochemically. Certain differences were noticed between these values, which are explained by the fact that in the total activities, besides the Ra and Th, other radioactive elements from the samples are also included. (Auth)

<1229>

Szilagyi, M., Sorption of Molybdenum by Humus Preparations. 1967. Geochem. Int. (Zagreb Transl.), 4, 1165-1167 (Nuclear Research Institute, Debrecen, Hungary)

The sorption of Mo by a peat fraction enriched in humic acids was studied to determine the role of the organic matter. The pH of the medium and the reducing properties of the humic acids are important in converting the MoO₄⁽⁻²⁾ ion to cationic Mo(+5), which can then be sorbed. (Auth)

<1230>

Talibudeen, O., Using Radiotracers in Soil Chemistry Research. CONF-711213; IAEA/SM-151/52; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships INCLUDING Applications in Forestry held in Vienna, Austria, December 13-17, 1971, p. (133-142) (Rothamsted Experimental Station, Harpenden, Herts, England)

Some models described summarize the more important chemical transformations in the soil-plant system and show how radioisotopes have helped recently to give a better and more precise understanding of these processes.

(Auth)

<1231>

Talvitie, N.A., Radiochemical Determination of Plutonium in Environmental and Biological Samples by Ion Exchange. 1971. Anal. Chem., 43, 1827-1830 (Western Environmental Research Laboratory, Las Vegas, NV)

The oxidizing and reducing properties of H₂O₂ in HCl are utilized for adsorption and desorption of Pu. Sample preparation procedures are given for several materials, including siliceous and limestone soils. The mean recovery of separated and electrodeposited Pu was 94%. (Soils and Fertilizers)

<1232>

Tamers, M.A., C.A. Ronzani, and H.W. Scharpenseel, Observation of Naturally Occurring Chlorine 36. 1969. Atompraxis, 15, 433-437 (University of Bonn, Bonn, German Federal Republic)

Cosmic ray secondary neutron-produced chlorine 36, with a half-life of 308,000 years, is applicable to the dating of Pleistocene events. However, the origin on the earth's surface produces a complication in the interpretations of the observed activities. The dating equation must be written with two ages, that of the exposure time and the time lapsed after removal from the surface, i.e., the decay age. Chlorine 36 is measured using the complete synthesis of silicon tetrachloride and liquid scintillation techniques. Determinations have been made in five samples consisting of ground water salts, soils, and mineral salts. Seawater has been used as the background material. The chlorine 36 concentrations are discussed and applications of the method illustrated. (Auth)

<1233>

Tamura, T., Reactions of Cesium 137 and Strontium 90 with Soil Minerals and Sesquioxides. 1964. Part of Transactions of the Eight International Congress of Soil Science held in Bucharest, Rumania, 1964. Publishing House of the Academy of the Socialist Republic of Rumania, (p. 465-478) (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Selective sorption reaction of cesium in microconcentration range is strongly favoured by a 10 Å 001 - spacing of the 2:1 layer lattice silicates. Chemical and heat treatments which alter the 001 - spacing of the minerals can drastically change the distribution coefficient for cesium. Explanations are offered for the observed influence of potassium treatments on cesium sorption in soils based on the lattice concept of selectivity. Sorption data for strontium are presented for several reference clay minerals and activated alumina. The possible strong influence of soil sesquioxides in sorbing strontium from radioactive waste solutions is suggested from data on soil materials. (Auth)

<1234>

Tamura, T., Cesium 137 Sorption Reactions as Indicator of Clay Mineral Structures. 1963. Clays and Clay Minerals, 10, 389-398 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

At low cesium ion concentrations extremely high selectivities for cesium are exhibited by

<1234> CONT.

layer lattice silicates with unexpanded 10 Å c-spacing. The total amount of cesium which can be sorbed by these minerals depends on the edge area and the exchange capacity. At a concentration of 10 (E-5) meq of cesium and 5 meq of sodium, a sample of biotite representing less than 0.025 meq of exchange capacity sorbed over 90 percent of the cesium and a hydrobiotite with 50 percent vermiculite and representing 1.0 meq of exchange capacity sorbed 80 percent of the cesium. After heating bentonites to 500-700 °C more cesium is sorbed from solutions containing high sodium concentrations by the heated bentonite than the original material. The change in the amount of cesium sorbed as a result of heating may be a useful property for detecting the presence of montmorillonite in mixed or interlayered mineral systems. Lattice expansion of biotite results in improved cesium sorption; this behavior is due to generation of sufficient favorable exchange sites to offset the loss of edges with favorable 10 Å spacing. (Auth)

<1235>

Tamura, T., Movement of Cesium 137 by Runoff, Erosion, and Infiltration from a Soil under Different Cover Conditions. CNF-671135; Part of Proceedings of a Symposium on Postattack Recovery for Nuclear War Held in Fort Monroe, Virginia, November 6-9, 1967, (p. 149-167) (Oak Ridge National Laboratory, Oak Ridge, TN)

In a two-year study, it was found that Cs 137 loss by runoff and erosion was significant, particularly in exposed bare-soil areas. In such conditions with an erosion loss of 23 tons per acre, 43 percent of applied Cs was lost. In vegetation-covered plots, runoff and erosion losses of Cs occurred primarily in the initial stages following application from washoff at a rate approximately 10 times that expected from soil loss alone. In the first year of the study, when Cs 137 was initially on the vegetation, loss of one ton per acre of soil resulted in a 20 percent Cs loss. Empirical logarithmic equations for the dependency of cesium loss on soil loss are given. It was found that considerable redistribution within a plot could occur and that cesium uptake by new vegetation represented a small part of the total applied. Most of the applied cesium that was not eroded was found in the top 3-cm layer of soil. (NSA)

<1236>

Tamura, T., Selective Ion Exchange Reactions for Cesium and Strontium by Soil Minerals. 1963. Part of Proceedings of an International Symposium on the Retention and Migration of Radioactive Ions in Soils held in Saclay, France, October 16-18, 1962 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

The basis for discharge of low and intermediate activity wastes into the ground is the retention of the nuclides, particularly cesium and strontium, by ion exchange on the soil particles. Studies at Oak Ridge have shown that minerals with the mica structure are efficient in selectively sorbing cesium. For the low concentration of cesium generally found in wastes, ion-exchange capacity is seldom the controlling parameter for its removal. Biotite, a primary mica mineral, will sorb cesium even more efficiently than vermiculite even though biotite has about 1% the exchange capacity of vermiculite. In a demineralized water system, montmorillonite with 90 meq/100g exchange capacity gave a

distribution coefficient (K_d) of 1700 ml per g, whereas illite with 20 meq/100g gave a K_d of 49,000. In the acidic pH range, ion exchange originating from isomorphous substitutions is the dominant mechanism for strontium removal by soils. In neutral and alkaline systems, additional reactions may occur. Hydrous oxides of iron and aluminum show high selectivities for strontium in this pH region. A Conasauga shale soil did not sorb as much strontium after being subjected to free iron oxide removal in spite of an increase in capacity resulting from the removal of the iron coating. An aluminum saturated montmorillonite showed the lowest removal of strontium at pH 6.0: when the pH was raised to 10, this sample removed more strontium than potassium, sodium or calcium saturated samples. Knowledge of the mechanisms responsible for selective ion exchange reactions made possible the preparations of materials which show even greater selectivities than their natural counterparts. Thus, in solutions high in sodium nitrate concentrations, montmorillonite heated to 600 °C and vermiculites saturated with potassium ions remove more cesium than the natural minerals. Gibbsite, an aluminum hydroxide mineral commonly found in soils, was made 50 times more selective for strontium by heating to temperatures which decomposed the mineral to the oxide. (Auth)

<1237>

Tamura, T., Selective Sorption Reactions of Strontium with Soil Minerals. 1965. Nuclear Safety, 7, 99-103 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

The reactions of radiostrontium with soils and clay minerals and with chemical solutions of soils and clay minerals containing microconcentrations of the radionuclide and macroconcentrations of dissolved stable ions are reviewed. In the reactions of strontium in soil-related systems, it is important not only to consider the clay minerals with their ion-exchange properties but also to remember that these systems may contain limestone and the hydrous iron and aluminum oxides commonly referred to as sesquioxides. The presence of the latter components appears to have little direct influence on cesium sorption, but these components can play an important role in strontium sorption. (Auth)

<1238>

Tamura, T., Selective Sorption Reactions of Cesium with Soil Minerals. 1964. Nuclear Safety, 52, 62-268 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Adsorption of radiocesium to hydrobiotite saturated with various cations demonstrated the selectivity of cesium adsorption to clay minerals. A short review of literature pertaining to the sorption reactions is presented. (CNF)

<1239>

Tamura, T., and D.G. Jacobs, Improving Cesium Selectivity of Bentonites by Heat Treatment. 1961. Health Physics, 5, 149-154 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Selectivity for cesium was improved by heating montmorillonites to temperatures in the range of from 600 to 700 degrees centigrade. The optimum temperature depends on the saturating cation and bentonite type. For

<1239> CONT.

montmorillonites heated in this temperature range and at higher temperatures, clay-solution contact time was an important consideration. Sorption characteristics over a wide range of cesium concentration were investigated; the results suggested a multifunctional exchange reaction for the 600 degrees centigrade calcium-montmorillonite and a simple mass action reaction for the oven-dried calcium-montmorillonite. The study of the influence of heating periods of 600 degrees centigrade for calcium-montmorillonite showed that longer heating periods resulted in a decreasing degree of initial sorption; however, cesium sorption gradually increased with solution-clay contact time and eventually exceeded the cesium sorption of oven-dried samples. These findings are significant for the understanding of clay mineral genesis and for applications in ground disposal of radioactive waste. (Auth)

<1240>

Tamura, T., and D.G. Jacobs, Structural Implications in Cesium Sorption. 1960. Health Physics, 2, 391-398 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

The results of this study help to explain the effectiveness of the local Conasauga shale for removing cesium from radioactive waste solutions. Illite, which is present in the shale has a particularly high affinity for cesium. The importance of the C-axis dimension of the 2:1 layer lattice clays was demonstrated by using synthetic micas and selected cation treatment. The beneficial role of potassium in the mica and illite is primarily because this element can induce and maintain collapse of the C-axis. Ion exchange capacities and surface area are secondary to the C-axis dimension in predicting the cesium sorption behavior of clays. The potassium treatment and oven-drying of clays followed by cesium sorption may be used to differentiate montmorillonite from vermiculite; the importance of the findings in terms of weathering and diagenetic processes involving clays is discussed. (Auth)

<1241>

Tamura, T., and E.G. Struness, Reactions Affecting Strontium Removal from Radioactive Wastes. 1963. Health Physics, 9, 697-704 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Alumina powder with an exchange capacity of about 1 mequiv/100 g removed as much strontium as a montmorillonite sample with 91 mequiv/100 g capacity when tested in a simulated waste solution of 0.1 M NaNO₃ containing 1.1 x 10⁻⁶ (E-e) M Sr(NO₃)₂ and in a basic pH. Additions of orthophosphate to the simulated waste solution resulted in improved strontium removal by CaCO₃ powder. With 5000 p.p.m. of orthophosphate, 0.5 g of CaCO₃ removed over 99 per cent of the strontium from 50 cm³ of simulated waste adjusted to pH 9. Under the same test conditions, natural vermiculite showed improvement, but sodium-saturated vermiculite showed a reduction in strontium removal. By pretreating vermiculite with solutions of NaCl and NaCl-NaOH, this mineral's affinity for strontium was improved, and an increase from 35 to 85 percent removal was obtained using a 0.5 g sorbent/50 ml solution ratio. From these slurry tests four possible mechanisms for removing strontium for radioactive wastes are suggested. These are: (1) ion exchange as an adsorption process

exemplified by vermiculite, clinoptilolite, and the clay minerals; (2) ion exchange as an adsorption process characterized by alumina and possible variscite; (3) metasomatic replacement as characterized by the CaCO₃-phosphate waste reaction; and (4) precipitation reactions as evidenced by natural vermiculite in contact with phosphated waste. (Auth)

<1242>

Tanner, A.B., Radon Migration in the Ground--A Review. 1964. Part of Adams, J.A.S. and Lowder, W.M. (Eds.), Natural Radiation Environment, University of Chicago Press, Chicago, Illinois, (p. 161-195) (U.S. Geological Survey, Washington, DC)

A review is presented in which factors that determine the distance that radon isotopes may migrate in the ground are discussed. The geophysical and geochemical implications of radon migration are also discussed. A bibliography of 162 references is included. (NSA)

<1243>

Tanner, A.B., Physical and Chemical Controls of Distribution of Radium 226 and Radon 222 in Ground Water Near Great Salt Lake, Utah. 1964. Part of Adams, J.A.S. and Lowder, W.M. (Eds.), Natural Radiation Environment, University of Chicago Press, Chicago, Illinois (p. 253-276) (U.S. Geological Survey, Washington, DC)

Chemical data are provided to supplement radioactivity data to promote understanding of Ra 226 and Rn 222 behavior in specified environments. Mechanisms of Ra 226 and Rn 222 control in ground water are suggested. Data and discussions are presented to support conclusions that Rn 222 content in the water is mainly dependent on sediment-contained Ra 226 near wells. Much of the Ra 226 is derived locally from Th 230, and additional Ra 226 may flow from upstream sources. Rn 222 anomalies in ground water may be related to changes in chemical environment. (NSA)

<1244>

Tasovac, T., and R. Radosavljevic, Uptake of Fallout Radioactivity by Plants on the Territory of the Boris Kidric Institute of Nuclear Sciences. 1970. CONF-690918-(Vol. 2); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 983-997), 506 p. (Boris Kidric Institute of Nuclear Sciences, Vinca, Yugoslavia)

In order to estimate the ecologic specific conditions of the environment and to evaluate the accumulation of radioactive nuclides in various components of ecosystems, systematic measurements of the radioactivity of plants were carried out for a long time at the Boris Kidric Institute of Nuclear Sciences. Correlations of the changes in radioactivity with specific environmental parameters are made. (Auth)

<1245>

Taylor, A.W., The Selectivity Coefficient of Slowly Exchangeable Calcium and Strontium. 1969. Soil Science, 107, 58-62 (U.S. Department of Agriculture, Agricultural Research Service, Soils Laboratory, Soil and Water Conservation Research Division, Beltsville, MD)

The slow approach to isotopic equilibrium shown by the exchangeable strontium in some acid soils of the North Carolina Coastal Plain

<1245> CONT.

is also exhibited by the exchangeable calcium. In these soils the exchange equilibrium between these ions may not be reached in less than one month. At equivalent fractions of calcium from 1.0 to 0.9 the slow exchange reaction does not show any significant selectivity for either ion, although the calcium may approach isotopic equilibrium a little more rapidly than the strontium. The slow exchange has no practical significance for the separation of calcium and strontium in field conditions, but has important implications for the interpretation of data from laboratory or pot experiments with soils in which it occurs. (Auth)

<1246>

Taylor, A.W., Strontium Retention in Acid Soils of the North Carolina Coastal Plain. 1968. Soil Science, 106, 440-447 (U.S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division, Soils Laboratory, Beltsville, MD)

When trace quantities of radiostrontium are equilibrated with some acid soils from the Coastal Plain of North Carolina for periods of 40 days, significant amounts sometimes 40 percent, cannot be recovered in rapid extraction with normal solutions of strontium nitrate. Isotopic equilibrium is approached only when the extraction is extended over a time equal to that taken for the original labelling. (Auth)

<1247>

Taylor, R.M., The Association of Manganese and Cobalt in Soils--Further Observations. 1968. J. Soil Sci., 19, 77-80 (Commonwealth Scientific and Industrial Organization, Division of Soils, Glen Osmond, S. Australia)

Soils from Bermuda, England, Greece, Israel, Lebanon and Yugoslavia were examined; a table gives their characteristics, Mn₂SO₄ contents, and distribution of manganese material. Soil Mn was mineralized as either birnessite or lithiophorite in five out of the seven soils. Most of the soil Co was associated with these minerals. This agrees with work on Mn in Australian soils and suggests that these minerals are the most common soil forms of secondary Mn minerals. (Soils and Fertilizers)

<1248>

Tensho, K., K.L. Yeh, and S. Mitsui, The Uptake of Strontium and Cesium by Plants from Soil with Special Reference to the Unusual Cesium Uptake by Lowland Rice and Its Mechanism. 1961. Soil and Plant Food, 6, 8 (University of Tokyo, Faculty of Agriculture, Tokyo, Japan)

Lowland rice showed an unusually high cesium uptake compared to that of upland crops. It appears the form of nitrogen fertilizer is responsible for the unusual behavior of lowland rice in cesium uptake; ammonium form appears to enhance plant uptake of cesium 137. (CWF)

<1249>

Tensho, K., K.L. Yeh, and S. Mitsui, Absorption of Radioactive Strontium by Soil, Especially in Relation to Native Calcium. 1961, December. Soil Science Plant Nutr., 7, 152-156 (University of Tokyo, Tokyo, Japan)

After shaking soil suspensions with carrier-free strontium 89, its absorption by

soil was examined in relation to soil Ca content and soil pH. The soil pH was changed by adding HCl, NaOH, or Ca(OH)₂. The distribution ratios of strontium 89 for 7 soils ranged from 0.7 to 3.9 percent, 72 to 94 percent, and 5.4 to 25 percent for the nonabsorbable, exchangeable, and nonexchangeable fractions respectively. With regard to the ratio strontium 89 to Ca, a significant difference was found between nonabsorbable and exchangeable fractions, and the degree of this unequal distribution between the 2 fractions was not identical among the soils tested. Maximum strontium 89 absorption by 3 soils was obtained by the addition of a small amount of NaOH to give a pH value of about 6.5 to 7, but its absorption was scarcely influenced by Ca(OH)₂. The ratio of strontium 89 to Ca of the nonabsorbable fraction was increased by lowering soil pH, and the reverse was found for the addition of Ca(OH)₂ and a small amount of NaOH. Autoradiographic experiments showed that the strontium 89 distilled water was accumulated on the surface of soil column, and the deposited strontium 89 barely migrated after washing with distilled water. Appreciable downward movement, however, was caused by washing with water containing Ca. (NSA)

<1250>

Tensho, K., K.L. Yeh, and S. Mitsui, The Uptake of Strontium 90 and Calcium by Lowland and Upland Rice from Soil, and their Distribution in the Plants. 1959. Soil and Plant Food, 5, 1-9 (University of Tokyo, Faculty of Agriculture, Tokyo, Japan)

The pot experiments, using strontium 90 and Tanashi volcanic ash soil, of lowland and upland rice were conducted by three different ways of applying Sr 90; basic mixed application with the upper two-thirds of the soil, basic surface application and top dressing at the young panicle formation stage (for lowland rice only). The amount of Sr 90 absorbed into plants differs depending upon the method of applying Sr 90. (Auth)

<1251>

Tensho, K., K.L. Yeh, and S. Mitsui, The Uptake of Cesium 134 and Potassium from Soil by Lowland and Upland Rice. 1959. Nippon Dojo-Hiryogaku Zasshi, 30, 253-258 (University of Tokyo, Faculty of Agriculture, Tokyo, Japan)

Not given

<1252>

Tewari, P.H., A.B. Campbell, and W. Lee, Adsorption of Cobalt(+2) by Oxides from Aqueous Solution. 1972. Can. J. Chem., 50(11), 1642-1648 (Atomic Energy of Canada, Ltd., Pinawa, Manitoba, Canada)

The transport of cobalt adsorbed on corrosion product oxides seems to be an important factor in the growth of reactor radiation fields. The adsorption of Co(+2) by Fe₃O₄, Al₂O₃, and MnO₂ was studied as a function of Co(+2) concentration, solution pH, and temperature. Adsorption of cobalt increased markedly with the solution pH between 5 and 7.5. Above pH 8 adsorption became increasingly masked by precipitation of Co(OH)₂ and no resolution of these two contributions to the loss of Co(+2) from solution was possible. A log vs. pH plot was linear between pH 5 and 7.5, where gamma is the fraction of occupied adsorption sites. The presence of 0.1 molar Ba(+2) and Mg(+2) in the solution does not seem to affect the hydrogen ion dependence of the adsorption of

<1252>

<1252> CONT.

Co(+2) on alumina. The adsorption results were analyzed by the Langmuir adsorption isotherm over a wide range of Co(+2) concentration (10(E-6) to 10(E-3) molar). The adsorption of Co(+2) was an endothermic process and increased markedly with temperature between 30 and 100 degrees centigrade. The heat of adsorption decreased with increasing surface coverage of the oxides. At saturation coverage, the heats of adsorption for Co(+2) on Al₂O₃, MnO₂, and Fe₃O₄ were -14.9, -14.3, and -6.3 kcal/mol, respectively. Hydrolysis of Co(+2) is suggested as a possible mechanism for the marked dependence of adsorption on pH and temperature. (Auth)

<1253>

Tewari, S.G., P.C. Ghosh, and A.S. Bhatnagar. Closed Circuit Technique for the Measurement of Radon/Thoron Ratio in Soil-Gas. 1968, March. Indian J. Pure Appl. Phys., 6, 33-36 (Department of Atomic Energy, New Delhi, India)

A closed circuit technique for measuring the Rn 226/Rn 222 ratio in soil gas as an aid to the geophysical method of prospecting by radon survey is discussed. This method is suitable for field applications and gives good statistical results in spite of limited available volume of soil gas and short half-life of Th. Significance of some experimental results are discussed. (Auth)

<1254>

Thomas, H.C., Some Fundamental Problems in the Fixation of Radioisotopes in Solids. 1958. Part of Proceedings of the Second United Nations International Conference on the Peaceful Uses of Atomic Energy, held in Geneva, Switzerland, September 1-13, 1958, (p. 37-42), 624p. (University of North Carolina, Chapel Hill, North Carolina)

The mechanisms of possible fixation reactions of radionuclides to various matrices in waste solutions were discussed. (CWF)

<1255>

Thomas, H.C., A New Method for the Measurement of Self-Diffusion. 1956. Proc. National Academy of Science, 42, 909-913 (Yale University, Department of Chemistry, New Haven, CT)

A procedure and supporting theory relating the measurement of self-diffusion coefficients of radioactive isotopes in wet solids are presented. (CWF)

<1256>

Thomas, W.A., and D.G. Jacobs, Curium Behavior in Plants and Soil. 1969. Soil Science, 108, 305-307 (Oak Ridge National Laboratory, Oak Ridge, TN)

Plant uptake of curium to foliage is so limited that introduction of hazardous quantities of Cm 242 into food chains is unlikely unless foliage becomes contaminated after release of this element to the atmosphere. The movement of curium was considered to be restricted by filtration and surface adsorption rather than exchange in ion exchange reactions. (CWF)

<1257>

Thomasson, W.W., W.E. Bolch, and J.F. Gamble. Uptake and Translocation of Cesium 134, Iron 59, Strontium 85, and Tungsten 185 by Banana Plants

and a Coconut Plant Following Foliar Application. 1969. Bioscience, 19, 613-615 (University of Florida, Gainesville, FL)

Soluble forms of W 185, Sr 85, Cs 134, and Fe 59 were applied to the fronds of the coconut palm and the leaves of the banana tree. Seventeen days after application of radioisotopes tissue samples were processed to a homogeneous state using a food blender. Gamma ray spectrometry was used for analysis of leaves, fruits, stems, and soil extracts. Computer analysis of the data showed a high selectivity for Cs 134 over the other three radionuclides. There was greater translocation in the banana plant than in the coconut. Cesium 134 exhibited measurable movement to adjacent plants 15 to 20 ft away. There was slight but measurable concentration of W 185 in the banana peels of the fruit from adjacent trees; however, no W 185 was found in the fruit. New, young leaves above the treated ones contained all of the radionuclides used, but Cs 134 was by far the most dominant. There was much less translocation of Cs 134 to the fruit of the coconut tree. Small amounts of W 185, Sr 85, and Fe 59 were translocated to untreated fronds above and on the opposite side of the palm from the treated fronds. (NSA)

<1258>

Thompson, J.C., Jr., Studies of Iodine 131 Uptake, Retention, and Removal in Food Plants. NYO-4039-1; (p. 99-112) (New York State Veterinary College, Ithaca, NY)

Iodine 131 was applied as a spray (NaI solution) to various pasture and food plants to examine uptake, retention, and removal characteristics under controlled conditions. Comparisons were made between pasture and various types of plants in an effort to develop some inter-relationships or indicator mechanisms that could be utilized under emergency releases of radioactivity. Data show a pasture to leaf lettuce ratio of 2:1, a pasture to green bean ratio of 60:1 and a pasture to tomato ratio of 180:1. Distribution of Iodine 131 on various plant parts indicated that the leaf and stem (or vine) portion received more than 80 percent of the activity. Time sequenced uptake in green beans showed an early 20 to 30 percent uptake pattern followed by an increase to the 50 or 60 percent level after 2 hr. Removal procedures (rinsing, boiling) were successful in eliminating 70 to 90 percent of Iodine 131 activity for most vegetables tested. (Auth)

<1259>

Thompson, J.C., Jr., Non-Milk Contribution of Iodine 131 to Diet: Experimental Iodine 131 Studies in Pasture and Food Plants. NYO-2147-13; (p. 152-159) (New York State Veterinary College, Department of Physical Biology, Ithaca, NY)

Green beans and pasture were grown in adjacent plots and contaminated with I 131 solutions. A bean/pasture ratio of 0.03 to 0.05 was indicated. Removal rates for washing were calculated and averaged 40 to 50 percent for field application studies. Laboratory studies indicate a similarity to field studies if similar air, light, and temperature conditions are present. Increasing I 131 concentration levels from 1 to 5 uCi I 131/liter did not influence removal rates under rinsing experiments. (Auth)

<1260>

Thompson, J.C., Jr., Radionuclide Plant and Soil

<1260> CONT.

Relationships under Normal Cultivation Practices. NYO-2147-13; (p. 168-174) (New York State Veterinary College, Department of Physical Biology, Ithaca, NY)

Soil and vegetable Sr 90 and Cs 137 levels show the effects of changes in fallout deposition rate during 1965 and 1966. Sr 90 levels for cultivated sites continue to be significantly less than from uncultivated sites. (Auth)

<1261>

Thompson, J.C., Jr., Soil and Vegetable Strontium 90 and Cesium 137 Levels on Sites under Continuous Cultivation. NYO-4039-1; (p. 121-126) (New York State Veterinary College, Ithaca, NY)

Experimental plots kept under continuous cultivation show patterns of Sr 90 and Cs 137 levels from 1963 to 1968. Soil levels during this period were relatively consistent, apparently increased deposition was nearly matched by soil losses associated with normal cultivation practices. In contrast vegetables generally showed declines in Sr 90 and Cs 137 content that followed lower deposition rate conditions from the atmosphere. (Auth)

<1262>

Thompson, J.C., Jr., Strontium Removal in Vegetables Prepared for Home Consumption. 1965. Health Physics, 11, 136-137 (New York State Veterinary College, Department of Physical Biology, Ithaca, NY)

Home preparation and cooking procedures for cabbage, carrots, green beans, onions, potatoes, and tomatoes removed from 19 to 55 percent of the Strontium 90 content of these 6 vegetables that make up nearly 75 percent of the total vegetable consumption in the U.S. Tomatoes were washed and sliced and the other vegetables were washed and boiled after preliminary preparation. All vegetables were analyzed for Sr 90 and Ca content before and after preparation and measurements were also made of the Sr 90 content in soils in which the vegetables were grown. Results indicate that root vegetables contain more Sr 90 than above ground edible parts and that the Sr 90 content of vegetables can be greatly reduced by home preparation methods. (NSA)

<1263>

Thornthwaite, C.W., J.R. Mather, and J.K. Nakamura, Movement of Radiostrontium in Soils. 1960. Science, 131, 1015-1019 (Laboratory of Clinatology, Centerton, NJ)

A model was developed for predicting movement of radiostrontium through soils. (CNF)

<1264>

Tiffin, L.O., J.V. Lagerwerff, and A.W. Taylor, Heavy Metal and Radionuclide Behavior in Soils and Plants, A Review. 1973, December. Unpublished Document (Agricultural Research Center, Environmental Quality Institute, Chemicals Management Laboratory, Beltsville, MD)

This report constitutes a review of the literature on the behavior of heavy metals and radionuclides in soils by three members of the ARS staff at Beltsville, Maryland. The report is directed more at examining movement in soil and uptake by plants of such heavy metals as Zn, Cu, Mn, Fe and Hg than radionuclides. Of the approximately 385 references only 61 are directly related to radionuclides. (CNF)

<1265>

Tikhomirov, F.A., F.M. Aleksakhin, E.A. Fedorov, and A.A. Molchanov, Radionuclide Migration in Forests and Radiation Effects on Woody Plants. 1971, June. A/CONF-49/P-685; CCNFP-710901; Part of Proceedings of the Fourth International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 6-16, 1971, 16 p. (State Atomic Energy Committee, USSR)

The problems of primary distribution and subsequent migration of major fission fragments in forest plantations under a single and continuous radioactive aerosol fallout from the atmosphere are discussed. Quantity parameters are evaluated, which describe the interaction between the aerosols and the forest vegetation, and the vertical migration of radionuclides in the forest cenosis (the coefficient of initial retention of radionuclides by the crowns of trees, the period of radionuclide half losses by wood plant trees, the vertical migration rate of radionuclides in the forest soil profile, and the quantitative uptake of radionuclides by the wood plants and the forest soil. The quantitative relationship between the radionuclide concentration in different components of the wood plants and the radiation doses is established. It is shown that during the fallout of a radioactive fission-products mixture from the atmosphere beta-radiation is the major contribution to the absorbed dose accumulated by meristematic tissues of the wood plants. The radioecological after-effects following the forest irradiation are described. These after-effects are caused both by the direct irradiation and by the secondary changes associated with the violation of the biogeocenotic links between individual components of the forest cenosis as a result of the ionizing radiation (changes in the growth process and forest development changes in the species structure of the forest implantation and the soil cover, the microclimate change under the cover of the forest and so on). A possibility of recovery of the forest damaged by ionizing radiation under conditions of the long-lived radionuclides high concentration in the forest soil is studied. (Auth)

<1266>

Tikhomirov, V.K., and N.V. Petrukhin, Determination of Radioruthenium in Environmental Objects. 1967, October. Gig. Sanit., 10, 87-92

The widespread peaceful application of nuclear energy makes it necessary to determine in the environment not only definitely harmful isotopes, such as Sr 90 and Cs 137, but also the less toxic Pu 103 and Ru 106 because they are formed at a high yield and have a relatively long half-life. They are accumulated in the soil and thus may contaminate reservoirs located near nuclear power plants. Metallic ruthenium was used as carrier for determination of the radioactive ruthenium isotopes. The analysis involved dissolution of the sample in sodium hypochlorite and precipitating black ruthenium hydroxide, soluble in hydrochloric acid. The samples were obtained by calcining specimens from the contaminated soils, together with plants at temperatures between 400 and 500 degrees centigrade. The ashes and the carrier were melted together with a strong oxidizing agent, such as caustics, potassium carbonate or nitrate, to destroy the silicate structure of the soil. Radioactive and carrier ruthenium were leached with water and sodium

<1266> CONT.

hypochlorite and were precipitated by iron, nickel, or aluminum hydroxide or mercury or copper sulfide. Radioactive isotopes were separated by distillation, extraction or ion exchange and were identified on the basis of their gamma peaks in the 0.5 Mev range. Ru 106 may also be identified by scintillation beta spectrometry, making use of its rhodium daughter product, Rh 106. (NSA)

<1267>

Tiller, K.G., J.P. Hodgson, and E. Pesch, Specific Sorption of Cobalt by Soil Clays. 1962. Soil Science, 95, 392-399 (U.S. Department of Agriculture, Ithaca, NY)

Adsorption of cobalt by 17 soils of widely different mineralogical composition and location was not greatly different. Pretreatments to these soils to determine the influence of soil organic matter and amorphous material appeared not to significantly influence the adsorption of cobalt in the presence of 0.1N CaCl₂. (CNF)

<1268>

Tiller, K.G., J.L. Honeysett, and E.G. Hallsworth, The Isotopically Exchangeable Form of Native and Applied Cobalt in Soils. 1969. Aust. J. Soil Res., 7, 43-56 (Commonwealth Scientific and Industrial Organization, Glen Osmond, S. Australia)

Isotopically exchangeable Co in different soils (prairie, clay podzol, humus podzol, yellow podzolic, krasnozems) varied from 0.16 to 5.4 parts per million and was highly correlated with the sum of Co extracted by CH₃COONH₄ and subsequently by quinol. The amounts of Co sorbed in the presence of CaCl₂ by different soils varied markedly between and within soil groups; sorption capacity for Co was highly correlated with Co content and surface area of the soils, and to a lesser extent with Mn and clay contents as well as pH. When soils rich in montmorillonite were excluded, highly significant correlations existed only with Mn and Co contents and surface area. (Soils and Fertilizers)

<1269>

Tiller, K.G., P. Wassermann, and H. Broeshart, Radioisotopic Techniques and Zinc Availability in Soil. 1971. CONF-711213; IAEA/SM-151/40; Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971, 13 p. (International Atomic Energy Agency Laboratory, Seibersdorf, Austria)

In this paper the principle of isotopic dilution in growing plants has been used to study availability of soil zinc to plants and to provide a reference method for the determination of total amount of available zinc. A series of greenhouse and growth room experiments were carried out to study the effects of different forms of added Zn 65, of plant species, of time of incubation of labelled soil, and of interaction with carrier zinc on the specific activity of zinc adsorbed by plants. The total amount of available zinc by this isotopic dilution approach was unaffected by plant species (buckwheat, wheat, clover, millet, rape and rice) although certain plants may not be very suitable for screening methods because of large contributions from seed zinc. Using millet as a test crop, different forms of introduced Zn 65 were tested, in solution form and in

adsorbed forms, with clay, resin and quartz sand as adsorbants. Identical results were obtained for all except for resin zinc. As might be expected, zinc adsorbed by a cation exchange resin tended to be more available to plants than other forms added and soil zinc. Because of the strong adsorption of zinc by many soils, the addition of carrier zinc with Zn 65 often resulted in overestimates of total amount of available zinc present naturally in soils. Finally, total available zinc was determined by glasshouse methods on a series of 25 soils from 20 countries. A measure of the soils ability to adsorb zinc near the zinc concentration in soil solution was obtained by labelling equilibrated soil suspensions with carrier free Zn 65. Some multiple regression analyses of the zinc content of plants and these availability data were made in terms of the quantity-intensity approach. With some restriction of soil type range, purely isotopic techniques give promise of useful reference procedures for zinc availability that are remarkably insensitive to experimental factors. (Auth)

<1270>

Timofeeva, N.A., On Migration of Radiostrontium in Biogeocenosis. 1960. Dokl. Akad. Nauk SSSR, 133, 488-491 (Institute of Biology, Academy of Sciences, USSR)

The migrations of Sr 90 in natural soil were observed for three years by using 3-mCi Sr 90 solutions placed at 2-cm and 5-cm depths in a 1.5 x 1.5 m area covered with grass. The content of Sr 90 was measured in plants and soil at concentric peripheries of 0 to 5, 5 to 10, 10 to 15, 15 to 20, 20 to 25, 25 to 35, and 35 to 45 cm and in a 70-cm soil cross section taken vertically and horizontally every 5 to 10 cm. The results show a limited Sr 90 migration from the initial spot. Moreover, the horizontal migration was twice the vertical. The faster horizontal migration is the results of transmission through the roots of plants. (NSA)

<1271>

Timofeeva, N.A., and N.V. Kulikov, Role of Freshwater Plants on Uptake and Distribution of Strontium 90 in Waterbasin Components. 1968. Tr. Inst. Ekol. Rast. Zhivotn., 61, 65-71

In spite of the relatively low (in comparison with other radioisotopes) coefficient of accumulation, the accumulation of Sr 90 was studied in 32 species of freshwater plants. Some species (CLADOPHORA FRAXTA, C. GLOMERATA, and POTAMOGETON COMPRESSUS) were capable of accumulating it in significant quantities (coefficients of accumulation from 1000 to 2000). The coefficients of accumulation for Sr 90 in living plants were related to the content of stable strontium, calcium, and magnesium in the water, but within broad limits did not depend on the specific radioactivity of the water. In the water-basin, the gravimetric ratio of the masses of water, soil, and plants was 85.0, 14.9, and 0.1 percent respectively. A significant part of the Sr 90 (about 58 percent of the total amount in the water-basin) remained in the water, 17 percent acted in the soil, and about 25 percent was accumulated by the plants. An increase in the content of calcium in the water decreased markedly the accumulation of Sr 90 by the soil and by the biomass of plants whereas it increased the Sr 90 content of the water. The discrimination between Sr 90 and calcium following their accumulation by the plants did not depend on the content of calcium in the

<1271> CONT.

water, but was determined to a significant degree by the individual peculiarities of the plants. The discrimination of Sr 90 following the formation of carbonate compounds by the plants did not depend on either the specific composition of the plants or the content of calcium in the water. The data on the kinetics of accumulation of Sr 90 by plants in relation to the content of stable strontium, calcium, and magnesium in the water and also the results of experiments on the separation of Sr 90 by plants suggest two possible processes that determine the capability of freshwater plants to accumulate this radioisotope: the one process--reversible, proceeding as a type of ionic exchange; the other--irreversible, proceeding at the expense of the coprecipitation of Sr 90 with calcium carbonates that are formed by the plant activity. As a result of carbonate formation, Sr 90 and calcium are partially excluded for a time from biological rotation in the water-basin. (tr-Auth)

<1272>

Titaeva, N.A., On the Character of Radium and Uranium Bond in Peat. 1967. *Geokhimiya*, 12, 1493-1499 (Moscow State University, Department of Geochemistry, Moscow, USSR)

In little-mineralized hydrocarbonate-calcic surface waters uranium is considerably more mobile than radium. Radium is well sorbed not only by clay sediments but also by peat. In peat uranium is bound to the fraction of humic acids and fluvoacids being soluble in alkalis, and radium to the insoluble residue. The bond of elements under oxidizing conditions has an exchange character. In the presence of great calcium amounts in water the radium bond in peat and in the insoluble residue becomes poorly exchangeable. In humic acid the exchange character of the radium bond is preserved. (tr-Auth)

<1273>

Titlyanova, A.A., Behavior of Cesium and Rubidium in Soils. 1962. *Soviet Soil Science*, 3, 277-284 (Academy of Sciences, Urals Branch, Institute of Biology, USSR)

The adsorption of cesium and rubidium in soils were conducted with columns, as well as static experiments under equilibrium conditions to determine the influence of extraneous cations and the concentration of the elements on their sorption and desorption in soils. It is shown that microquantities of cesium have a very low mobility in the soil. They are almost completely sorbed by the first layer of the soil column and are not desorbed by lake water. A greater stability of the bond between the soil and microquantities of cesium, as compared to micro-quantities of rubidium, was also found in the static experiments. The results of experiments on the desorption of cesium and rubidium by various cations, as well as the difference in the relationship between the behavior of the elements and their concentration in the soil indicated that there are three forms of adsorbed cesium and two forms of adsorbed rubidium. The predominance of one or the other form in the soil depends on the concentration of the element adsorbed. The specific sorbed form of cesium predominates at micro-concentrations, less than $10(E-7)$ equiv/q of soil, bound cesium in the range of $10(E-5)$ to $10(E-7)$ equiv/q of soil, and exchangeable cesium at a concentration of $10(E-4)$ equiv/q of soil. The exchangeable form of rubidium predominates at a

concentration of $10(E-4)$ equiv/q of soil, and the bound form, at concentration $< 10(E-5)$ equiv/q of soil. (Auth)

<1274>

Titlyanova, A.A., Sorption of Cesium by Soil Layer Minerals. 1964. *Soviet Soil Science*, 12, 1313-1318 (Academy of Sciences, Urals Branch, Sverdlovsk, USSR)

It was concluded that the specific sorption of microquantities of cesium is effected by secondary layer clay and primary micaceous minerals that are present in all soils. The behavior of microquantities of cesium in each soil is determined by its mineralogical composition. (Auth)

<1275>

Titlyanova, A.A., The Effect of Cesium Concentration on its Accumulation in Plants. 1963. *Dokl. Akad. Nauk SSSR*, 152, 441-442; JPRS-22656 (Academy of Sciences, Urals Branch Sverdlovsk, USSR)

Data are presented from studies on the absorption of Cs 137 by pea plants and wheat plants from feed solutions and from soil when various concentrations of Cs were used. Cesium reactions in soil-solution systems are discussed. Results indicate that the Cs bond with soil changes with variation in its concentration (NSA)

<1276>

Titlyanova, A.A., and N.A. Timofeeva, The Sorption of Radioactive Isotopes by the Soil. 1964. *Tr. Inst. Biol., Akad. Nauk SSSR, Ural. Filial*, 22, 17-29 (Not given)

Cs, Sr and Zn (occurring in solution as cations) and Co, I and Fe showed over 90% sorption in meadow soil. Ce, Ru, Zr and Nb showed only 50-60% sorption (evidently in solution sorbed and non-sorbed forms occur). SO_4 and PO_4 were sorbed to a less extent than cations. In desorption tests with lake water there was almost complete desorption of $SO_4(+2)$, significant desorption of Sr, Zr and $PO_4(+2)$, some desorption of Fe, Nb, Ru, no significant desorption of Co, Zn and Ce and no desorption of Cs and I. A direct relationship existed between the amount of sorbed Sr and the amount of exchangeable cations in the soil. (Soils and Fertilizers)

<1277>

Titlyanova, A.A., and N.A. Timofeeva, Mobility of Compounds of Cobalt, Strontium, and Cesium in the Soil. 1959. *Soviet Soil Science*, 3, 346-351 (Academy of Sciences, Urals Branch, Sverdlovsk, USSR)

It was determined in static experiments that sorption of cesium by the soil is specifically affected by potassium while sorption of cobalt is influenced by calcium and magnesium. This fact evidently indicates that during sorption of cesium and cobalt by the soil, nonsoluble compounds of these elements are formed. (Auth)

<1278>

Todorovic, Z., and A. Filip, Movement of Complex Compounds through Different Soil Types. 1967. CONF-670641; STI/PUB-158; Part of Proceedings of a Symposium on the Use of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies held in Istanbul, Turkey, June 12-16, 1967, (p. 241-249) (Boris Kidric Institute of Nuclear Sciences, Belgrade, Yugoslavia)

<1278>

<1278> CONT.

Results of the behavior of complex compounds of zinc (bivalent), iron (trivalent), cobalt (trivalent) and chromium (trivalent) on passing through four sorts of soils are given. The soils had a dominant content of sand, clay, humus and carbonate. The investigations were carried out by the radioactive tracer technique. The complexing was carried out with Na-citrate, EDTA, Na-thiocyanate, potassium cyanide, ammonium-hydroxide, Na-oxalate, Na-tartrate and Na-citrate. The effect of the excess complexing agent on the percentage of the complex compound in the eluate, retention and spread of the elution curve is shown. The investigations were carried out on a column always filled with the same quantity of soil granulation. The movement of the complex compound was observed by taking samples of the eluate and measuring their activity. For each elution curve parameters difference between retardation and sigma were determined as a measure for the retardation and spread of the complex compound waves. The smaller the difference between retardation (X_{bar}) and free Volume ($X_{sub 0}$) and the smaller the standard deviation, the smaller was the retardation of the complex compound. From these characteristics and from those of the elution curves for I 131 and S 35, which are considered to be passing through the soil without considerable difficulty, those complex compounds which showed the least retardation and wave spread on passage through the soil type investigated were determined. (auth)

<1279>

Torok, I., Determination of Cesium 137 in Soils by Means of a Ge(Li) Detector. 1971. *Agrokem. Talaitan*, 20, 203-204 (Not given)

The installation described comprises a 32 Cm3 Ge(Li) crystal thermostatically controlled at the temperature of liquid N, an analyzer linked to a computer and a monitor. Other radionuclides (Co 60, Ru 106, Na 22, and Ra 226) can also be determined. (Soils and Fertilizers)

<1280>

Tso, T.C., Limited Removal of Polonium 210 and Lead 210 from Soil and Fertilizer by Leaching. 1970. *Agronomy Journal*, 62, 663-664 (U.S. Department of Agriculture, Agricultural Research Service, Crops Research Division, Beltsville, MD)

Radioelements Po 210 and Pb 210 are known to be present in plants. They enter the plants primarily by root absorption. Heavy and continued fertilization increases the level of radio-elements in soil and thus in crops so produced. Results obtained from laboratory experiments show that there is limited removal of Po 210 and Pb 210 by leaching from soil or from fertilizer. Mechanical agitation appeared to increase the leaching rate of these elements. Generally, Po 210 was leached from soil or from soil-fertilizer mixture much easier than Pb 210, with or without agitation. (Auth)

<1281>

Tso, T.C., J.M. Carr, E.S. Ferri, and E.J. Baratta, Agronomic Factors Affecting Polonium 210 and Lead 210 Levels in Tobacco. II. Varieties and Curing Methods. 1968. *Agronomy Journal*, 60, 650-652 (U.S. Department of Agriculture, North Carolina State University, Agricultural Research Service, Crops Research Division, Oxford, NC; U.S. Public Health Service, Division of Radiological Health, Winchester, MA)

Tobacco seedlings accumulated Pb 210 and Po 210 to a concentration much higher than that found in the soil. The levels of these radioelements decreased as the plants grew. Only minor differences were observed in harvested leaves of two flue-cured varieties--'Coker 319' and 'Virginia Bright Leaf'. The Pb 210 and Po 210 content in the seeds are in much lower levels than those in the respective leaves produced from the same plant. Neither of the two methods of flue-curing--a closed system with wood or an open system with kerosene--resulted in significant differences in radioisotope levels of cured leaf. Pb 210 and Po 210, if present in the combustion products of wood, were trapped in or exhausted through the flue pipes and were not deposited on the tobacco. Kerosene, because it contains little radioactivity, would not contribute much to the Pb 210 and Po 210 level of cured leaf when fully exposed to products of combustion in an open system. (Auth)

<1282>

Tso, T.C., and I.M. Fisenne, Translocation and Distribution of Lead 210 and Polonium 210 Supplied to Tobacco Plants. 1968. *Radiation Botany*, 8, 457-462 (U.S. Department of Agriculture, Beltsville, MD)

Lead 210 and polonium 210 were supplied to tobacco plants (NICOTIANA TABACUM L. cv. Maryland Catterton) from soil, stem, and leaf surface to study the patterns of translocation and distribution of these elements. Test plants took up Po 210 and Pb 210 from roots or stems and the elements were distributed to various tissues. Direct absorption of Po 210 is therefore considered a major source of Po 210 supply, in addition to that from ingrowth of Pb 210 in leaf tobacco. A higher concentration of Pb 210 accumulated in younger upper leaves than in older lower leaves, while a higher concentration of Po 210 accumulated in older lower leaves than in younger upper leaves. When the two elements were applied to the leaf surface, little translocation or redistribution of Pb 210 was found from one leaf area to other leaf areas, but a very small portion of Po 210 applied on younger upper leaves transferred to older lower leaves. Po 210 applied on older lower leaves, however, remained where placed. (Auth)

<1283>

Tso, T.C., N.A. Hallden, and L.T. Alexander, Radium 226 and Polonium 210 in Leaf Tobacco and Tobacco Soil. 1964, November. *Science*, 146, 1043-1045 (U.S. Department of Agriculture, Beltsville, MD)

Contents of radium 226 and polonium 210 in leaf tobacco and tobacco-growing soils were found to vary with the source. The differences may result from production locality, culture, and curing. The polonium seems to be not entirely derived from the radium, plants probably take it up from the soil or air. (Auth)

<1284>

Tso, T.C., G.L. Steffens, E.S. Ferri, and E.J. Baratta, Agronomic Factors Affecting Polonium 210 and Lead 210 Levels in Tobacco. I. Soil and Fertilizer. 1968. *Agronomy Journal*, 60, 647-649 (U.S. Department of Agriculture, Agricultural Research Service, Crops Research Division, Beltsville, MD; U.S. Department of Health, Education, and Welfare, Public Health Service, Division of Radiological Health, Winchester, MA)

<1284> CONT.

An examination of soils from tobacco-producing areas and fertilizers commercially available for tobacco production revealed that a wide variation in the levels of Ra 226, Pb 226, and Po 210 exists in those samples. Cultural practices and source of fertilizer may contribute to these variations. Radioelements from fertilizer used for one growing season may not affect the level of these elements in the immediate crop, but will contribute to the buildup of the radioisotope level in the soil. (Auth)

<1285>

Tuominen, Y., Studies on the Translocation of Cesium and Strontium Ions in the Thallus of CLADONIA ALPESTRIS. 1968. Ann. Bot. Fenn., 5, 102-111 (University of Helsinki, Helsinki, Finland)

The extent to which the thallus of the dead lichen C. ALPESTRIS was able to take up and translocate Cs 137 and Sr 90 was studied. Silica gel was used as an accelerating factor to investigate whether under natural conditions wind promoted the translocation of these cations. The unexpectedly rapid translocation that was observed seemed, with respect to Cs 137, to fit a diffusion equation in unidimensional form. Silica gel used as a simulator of wind had an accelerating effect on the translocation of both cations. The results of these experiments could be approximately reproduced with a diffusion model. The characteristic difference in the vertical distribution of Sr and Cs ions demonstrated the cation exchange ability of the thallus. The concentration distribution of the Sr ions fit a diffusion model in which the diffusion coefficient passes through a maximum between the base and top of the thallus. Introduction of reflection at a boundary in connection with the results of the lichen simulator experiments made it easier to explain the shape of the curves showing the accumulation of cations at the tops of the thalli and also supported the assumption that translocation of Cs and Sr along the thallus was primarily diffusive in character but complicated by cation exchange, especially with respect to Sr ion. (NSA)

<1286>

Tyuryukanova, E.B., Landscape-Geochemical Aspects of Strontium-90 Migration. 1973. Part of Klechkovskii, V.M. (Ed.), Radioecology, John Wiley and Sons, Inc., New York, New York, (p. 69-77), 381 p. (Not given)

A review of studies on Sr 90 migration is presented. The distribution of Sr 90 in the bogged soils of Polyvye forest zones was related to the distribution of Fe, while in the steppe zone it was related to the distribution of Ca and stable Sr. The influence of various environmental factors such as runoff direction, shape of depression, exposure, and vegetation on Sr 90 migration is discussed. The distribution of Sr 90 in root systems and aerial parts of plants is discussed and a table is presented to show Sr 90 concentrations in lichens, mosses, grasses, and other plants. Other topics discussed are effects of physicochemical properties of soils on migration and distribution of Sr 90 and Sr 90 concentrations in humid (forest) regions and arid (steppe) zones. (NSA)

<1287>

Tyuryukanova, E.B., Methods of Studying the Behavior of Radiostrontium in Soils of Different

Geochemical Regions. Not given.

A-AC-82/G/L-1253; AEC-tr-7030; p. 134-144 (Not given)

Through proper understanding of basic soil-geochemical mechanisms, the distribution, movement and concentration sites of radiostrontium in soil profiles of various landscapes should be ascertained. On this premise, large scale investigations were carried out evaluating the distribution of radiostrontium in various soil profiles of differing geochemical regions. Very low strontium 90 concentrations were found in sandy-terrace soils covered with pine forrests, while high concentrations were evidence in prairie-chnozem soils of the upland plains. Calcareous horizons in the latter soils were thought to be responsible for strontium accumulation. (CWF)

<1288>

Tyuryukanova, E.B., and V.A. Kaluzhina, The Behavior of Thorium in Soils. 1971. Soviet Journal of Ecology, 2(5), 467-469 (Vernadskiy Institute of Geochemistry and Analytical Chemistry, USSR)

The distribution of thorium in a number of soil profiles was determined. Peaty horizons and buried peats contained the lowest thorium concentration. Alluvial soils contained twice as much as arid forest podzol soils and in sandy ferruginized soils thorium accumulated in the ferruginous humus horizon. These observations indicate the mobil nature of thorium. The humus horizons of water meadow soils contained higher amounts of thorium than other horizons indicating biological cycling in these soils. The low thorium content in the peaty soils and horizons was thought to be due to the limited uptake of thorium by bog plants. (CWF)

<1289>

Tyuryukanova, E.B., N.I. Konova, and S. Soboiev, Radioactive Strontium in the Pasture Soils of East Pamir. 1971. Ecology (USSR), 2, 31-34 (Vernadskiy Institute of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR)

The content of strontium 90 in soils of East Pamir varied from 12 to 70 nCi/m². Soils can be arranged in the following order with respect to its increasing content: takyr-like < strongly stony desert-steppe < desert < high-mountain frozen meadow < solonchakish desert < meadow soil. The content of strontium 90 in soils depends on the degree of cracking and stoniness of the soils and content of humus; the role of the relief decreases under the effect of other factors. Large fractions of the particle-size distribution, represented by carbonates, adsorb a considerable amount (up to 50%) of strontium 90. Its content in meadow plants is 1000-3500 pCi/kg. In grasses strontium 90 is concentrated in the roots, whereas in winterfat and wormwood it is concentrated in the aerial parts. (Auth)

<1290>

Tyuryukanova, E.B., N.I. Konova, and S. Soboiev, Radioactive Strontium in the Soil-Plant Cover of Pastures of the Eastern Pamirs. 1971. Ekologiya, 1, 45-48 (Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

Soil and plant samples were collected from different regions of the eastern Pamirs at altitudes of 3500 to 4800 m. Radiochemical analyses of HCl extracts of soils and plants

<1290> CONT.

were made for Sr 90 content. The soil content of Sr 90 was in the range of 12 to 70 uCi m. The Sr 90 content of the soil was related to disintegration, humus content, and stoniness. The Sr 90 content of plants was 1000 to 3500 uCi/kg depending on altitude. Some plants accumulated Sr 90 primarily in their above-ground parts, while other species accumulated Sr 90 mostly in the roots. The Sr 90 accumulation was also related to the rainfall in the area. (NSA)

<1291>

Tyuryukanova, E.B., F.I. Pavlotskaya, and V.I. Baranov, Distribution of Radioactive Strontium in the Soils of Different Natural Zones. 1967. A-AC-82/G/L-1176 (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

The distribution of Sr 90 in the soil-vegetation cover was determined, together with content of this isotope in fallout, by a complete series of natural factors, among which the most significant are the type of soil and the geomorphological and hydrometeorological conditions. Strontium 90 is most stably bound in soils with high humus content and with heavy mechanical composition. In bottom soils a high mobility of the Sr 90 was observed. The discrepancy in the behavior of stable and radioactive strontium in years with a high level of precipitation is explained both by the different sources and forms of its inflow to the soil and by the different times of interaction. The vertical migration of radiostrontium depends on the genetic structure of the soil. Sr 90 is impeded in humus levels, washed out through podzolic level, and bound in alluvial levels. (tr-Auth)

<1292>

Tyuryukanova, E.B., F.I. Pavlotskaya, and V.I. Baranov, Specific Features of Strontium 90 Distribution in Different Soils in the European Region of the USSR in 1961. 1965. NP-16527; 19 p. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, USSR)

Strontium 90 was determined in various soils, at depths from 0 to 150 cm, in grassy and dry steppe and young taiga regions. The distribution of this nuclide was found to depend on several factors, e.g., on the type of soil, especially the organic content, stratification, and nature of the vegetation. The Strontium 90 content was maximum in the high-humus, black soils. In the peaty podzols it was concentrated in the upper part of the layer under the friable, slightly decomposed litter. In the black earth and peaty soils, Strontium 90 was distributed more uniformly. In swampy soils it was concentrated in the humus layer and was practically absent from the gley. In salt marsh soils it was found in the salty crust and the upper part of the gypsum layer. (NSA)

<1293>

Tyuryukanova, E.B., F.I. Pavlotskaya, A.N. Tyuryukanov, L.N. Zatssepina, E.V. Babicheva, and L.M. Rodionova, Movement and Distribution of Strontium 90 and Cerium 144 in the Soils of Moscow Oblast. 1964. Soviet Soil Science, 10, 1063-1068

The distribution in the soil of radioactive strontium and radioactive cerium of atmospheric origin is governed by the nature of the compounds of these radioactive isotopes, the rate and nature of fallout

(aerosols, rain), the properties of the soil, and the characteristics of the vegetation. In the virgin soils the maximum content of these radioactive isotopes was limited to the first humified layer, which was from 1-2 cm thick. The bulk of the radioactive isotopes was concentrated in the 0- to 5-cm layer. In plowed soils the distribution of strontium 90 and cerium 144 within the plow layer was relatively uniform, caused by the mixing of soil during cultivation. Below a depth of 20-25 cm the content of radioactive strontium and radioactive cerium in the soils studied was almost undeterminable analytically. The results of the present work indicate a lower level of mobility in the soil for radioactive cerium as compared with radioactive strontium. (Auth)

<1294>

Tyuryukanova, E.B., F.I. Pavlotskaya, A.N. Tyuryukanov, and V.I. Baranov, Chemistry and Agrochemistry of Soils Distribution of Strontium 90 in the Top Horizons of Soils in Relation to the Soil Group and Landscape. 1964. Soviet Soil Science, 8, 853-859 (Vernadskiy Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

Zones of radiostrontium accumulation in soils are confined to floodplains and bog depressions. Radiostrontium is least abundant in eluvial (water divide) geochemical landscapes. The extent of radiostrontium accumulation in floodplain soils varies largely with the physicogeographical features of the floodplain. Vertical distribution through the profile varies with the genetic soil group, nature and thickness of the humus horizon, and climatic and hydrological conditions of each geochemical landscape. (Auth)

<1295>

Tyuryukanova, E.B., F.I. Pavlotskaya, and V.I. Baranov, Peculiarities of Radiostrontium Distribution in Some Landscapes of the Southern Taiga. 1967. CONF-660405; Part of Aberg, B. and Hunkate, F.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium, held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, (p. 33-37), 1051 p. (Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

In outwash landscapes of the southern taiga some years after nuclear weapon tests the radiostrontium is distributed analogously to stable strontium. The discrepancy in the behavior of stable radioactive strontium in years with a substantial level of fallout is accounted for both by the different sources and the forms of its supply to the soil and by the different time of interaction with the soil. The vertical migration of radiostrontium depends on the genetic structure of soils. Strontium 90 is retained in humus horizons, washed out through podzolic layers and fixed in illuvial ones. (Auth)

<1296>

Tyuryukanova, E.B., F.I. Pavlotskaya, A.N. Tyuryukanov, and V.I. Baranov, Studying Radioisotope Migration in Soils. Distribution of Strontium 90. 1964. Pochvovedenie, 8, 88-95

Sr 90 from the atmosphere was found to accumulate on poorly drained unswamp bottomlands and in water-logged depressions adjacent to sandy watersheds. The vertical distribution of Sr 90 in a given geochemical

<1296> CONT.

landscape was found to depend on the genetic soil type and the character and thickness of its humose horizon. (Auth)

<1297>

Tyurvukanova, E.B., P.I. Pavlitskaya, A.N. Tyurvukanov, L.N. Zatssepina, E.V. Babicheva, and L.M. Rodionova, Migration and Distribution of Strontium 90 and Cerium 144 in Soils of Moscow Region. 1964. Pochvovedenie, 10, 66-73

Distribution of radioisotopes in genetic horizons of the soils of Moscow region was studied. It was found that Sr 90 and Ce 144 are distributed in soil profiles according to not only the soil type but also vegetation, geomorphology, and other conditions. (Auth)

<1298>

Ubell, K., Investigations into Groundwater Balance by Applying Radioisotope Tracers. 1967. CONF-661133; STI/PUB-141; Part of Proceedings of a Conference on Isotopes in Hydrology held in Vienna, Austria, November 14-18, 1966, (p. 521-530), 740 p. (Research Institute for Water Resources, Budapest, Hungary)

In loose sediments with a pore-type porosity two general types of water movement influencing the groundwater balance at natural conditions must be distinguished, namely: water transfer of vertical direction in unsaturated soils, i.e., water movement in the aeration zone above water table; and water movement in the saturated zone, i.e., horizontal flows in groundwater body. Owing to numerous factors, groundwater balance is a highly complex process. For determining the quantitative features, experimental field tests are of great importance. The methods used and the results obtained in Hungary in connection with field tests applying radioactive tracers for solving the problems of natural groundwater balance are presented. Moisture movements taking place through the aeration zone and, based on this process, the recharge due to precipitation and the evaporation loss of groundwater have been determined by systematic soil-moisture measurements carried out in whole vertical profiles, from the land surface down to the water table, with the aid of neutron-diffusion, based on the application of radioactive isotopes of Pu-Be source-detector as neutron radiation emitter. The flow of groundwater, i.e., the natural horizontal movement in the zone of aeration, and also the velocity distribution according to depth and the natural flow-rate of groundwater, were studied by multi-well tracing and single-well techniques by using I 131 tracer. (Auth)

<1299>

Uhler, R.L., Insolubility as a Factor in Strontium 90 Availability to Plants. 1960. HW-65500: (p. 42-48) (Hanford Laboratories, Biology Operation, Richland, WA)

The uptake of Sr 90 from compounds of varying solubility which were mixed in soils was followed over an extended period. Differences in uptake suggests Sr 90 in the presence of phosphate and calcium carbonate is fixed in the formation of hydroxyapatite. Massive applications of phosphate to a calcareous soil contaminated with soluble Sr 90 reduced Sr 90 uptake and supports hydroxyapatite fixation of Sr 90. (Auth)

<1300>

Uhler, R.L., and F.P. Hunkate, Relative Availability of Some Strontium 90 Compounds in Soil. 1960. Nature, 187, 252-253 (Hanford Laboratories, Biology Operation, Richland, WA)

The relative plant availability of strontium from various chemical forms (nitrate, chloride, sulfate, carbonate, etc.) added to three soils (one acid and two calcareous) is presented. In calcareous soils the availability from the carbonate and phosphate forms is the smallest. (CWF)

<1301>

Underdahl, B., The Influence of the Soil and the Way of Farming on the Strontium 90 Concentration in Milk. 1967. CONF-660405; Part of Aberg, B. and Hunkate, F.P. (Eds.), Radioecological Concentration Processes, Proceedings of an International Symposium held in Stockholm, Sweden, April 25-29, 1966. Pergamon Press, Oxford, England, (p. 73-76), 1051p. (Veterinary College of Norway, Institute of Food Hygiene, Oslo, Norway)

The factors of farm management, principally fertilization practices, were shown to influence contact of strontium 90 in milk produced on these farms. In general, intensive farming practices depressed radiostrontium content of milk. (CWF)

<1302>

Usacev, S., and Z. Dobiasova, Calculation of Strontium 90 Content Changes in Atmospheric Fallout and on the Ground in West Slovakia up to the Year 2000. 1970, December. Jad. Energ., 16, 420-421 (University of Komenskeho, Bratislava, Czechoslovakia)

Theoretical studies of measured data on Sr 90 distribution resulted in calculated values for Sr 90 hold-up time, $T(a)$, in the atmosphere and of the Sr 90 content on the ground in West Slovakia to the year 2000, assuming no further nuclear tests. The values measured in Jaslovské Bohunice for 1962 to 1966 were used in the calculations. (Auth)

<1303>

van den Hoek, J., and R. Kirchmann, Strontium 85 and Cesium 134 Activity in Milk After a Single Contamination of Pasture. 1968, September. Tijdschr. Diergeneesk., 93, 1121-1132 (University of Wageningen, Wageningen, Netherlands)

The development of milk activity of Sr 85 and Cs 134 after a single contamination of an old permanent pasture and a newly sown in temporary sward in the early and late phases of the grazing season has been studied. Both nuclides are rapidly secreted into milk and obtain their highest values in 4 to 7 days after the cows have access to contaminated pasture. The difference in type of pasture has no influence on the maximal activity per litre of milk. However, the decrease in concentration of strontium and cesium in milk appears to occur more slowly on temporary than on permanent pasture. The transfer coefficients for strontium (the percentage of the deposited activity per m² or of the activity of grass per kg dry matter respectively, which is secreted per litre of milk) remained about the same for all four experiments and varied between about 1 to 1.5 percent and 0.30 to 0.45 percent respectively. In contrast to this, the transfer coefficients for cesium have values two to three times higher for the August and September experiments; they vary from about 5

<1303>

<1303> CONT.

to 17 percent and from 2 to 4 percent respectively. The possible reasons for this differential behavior of cesium are discussed but a satisfactory explanation cannot be given. Finally, the health physics aspects of the results of this experiment are reviewed. (Auth)

<1304>

van den Hoek, J., R. Kirchmann, J. Colard, and J.E. Sprietsma, Importance of Some Methods of Pasture Feeding, of Pasture Type, and of Seasonal Factors on Strontium 85 and Cesium 134 Transfer from Grass to Milk. 1969. Health Physics, 17, 691-700 (Agricultural University, Wageningen, Netherlands)

The activity of Sr 85 and Cs 134 was investigated in the milk of three groups of cows after deposition of the radionuclides on pasture under field conditions by a spraying technique at four different moments of the grazing season. The animals were kept according to three different methods of feeding: green soiling, rotational grazing and free grazing. Sr 85 milk levels were found to be significantly lower in the free grazing group which also showed the greatest variations in Cs 134 milk levels. No differences in milk activity could be demonstrated according to whether the cows grazed on an old permanent or a newly sown, temporary pasture. A highly significant seasonal effect on Cs 134 levels in milk was seen to occur in all groups, their milk activity increasing by a factor of about 1.5 to 3 for the late summer experiments whereas Sr 85 levels remained fairly constant. This different behavior of the two radionuclides could be explained for the animals of the green soiling group by changes in transfer coefficient and variations in ingested radioactivity. The transfer coefficient from grass to milk was determined in the green soiling group. It ranged from 0.31 to 0.45 percent for Cs 134 and from 0.05 to 0.07 percent for Sr 85, the lowest transfer of Cs 134 and the highest of Sr 85 being recorded at the beginning of the grazing seasons. The importance of some factors which might have influenced milk activity in the other groups, is discussed. (Auth)

<1305>

van der Westhuizen, H.J., and H.A.J. van Rensburg, Movement of Some Nuclear Fission and Activated Products in Duinefontein Soil. 1973, February. PEL-226; 15 p. (Pretoria, Chemical Operations Division, Pretoria, Republic of South Africa)

As part of the site investigation in connection with the erection of the first South African nuclear power station, Koeberg A. (Escom reactor) the movement in the ground of important products of nuclear fission and activation is being investigated. The sorption capacity of different layers of the ground for the elements was determined by laboratory tests. The tests were conducted using a solution which corresponds to the groundwater of the reactor site. The results of these tests were used to calculate the relative speed of the ion front of each element in relation to the liquid front. The values obtained indicate that the speeds at which the various elements move through the ground under the influence of the moving groundwater are spread out over a wide range. (Auth)

<1306>

Varqa, J.A., and D.G. Jacobs, Dissolution of Calcium-Strontium Carbonate and Its Subsequent Movement in the Ground. 1970, November. ORNL-TM-3130; 14 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

A series of laboratory experiments was performed to determine the relative behavior of strontium and calcium in the dissolution of strontium-contaminated calcium carbonate and subsequent movement through a mineral exchange system. The behavior of the two elements was found to be similar, and their release from the system was directly related to the amount of hydrochloric acid used in the leaching process. (Auth)

<1307>

Varshal, G.M., I.Ya. Koshcheeva, and R.P. Morozova, Possible Forms of Ruthenium Migration in Surface Waters and Soils. 1972. Geokhimiya, 8, 971-979 (Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

The interaction of ruthenium (+4) with organic matter isolated from the effluents of the Moscow River, including their main component--fulvic acids, was studied. The formation of stable anionic forms of complex compounds of ruthenium (+4) with fulvic acid was studied by means of solubility and electrophoresis. Ruthenium solubility increases in the presence of fulvic acids by 2 to 4 orders in comparison with ruthenium solubility in water in the absence of organic matter. The conventional equilibrium constant of the reaction of ruthenium interaction with fulvic acids was calculated. The relatively high capacity of ruthenium for migration in waters and soils was considered from the standpoint of its complexing with the organic matters of water. (Auth)

<1308>

Vaughan, B.E., E.C. Evans, III, and M.E. Hutchin, Polar Transport Characteristics of Radiostrontium and Radiocalcium in Isolated Corn Root Segments. 1967. Plant Physiology, 42, 747-750 (U.S. Naval Radiological Defense Laboratory, Biological and Medical Sciences Division, San Francisco, CA)

Polar transport of strontium was found to be similar to calcium. Sections of corn roots mounted in a specially designed perfusion assembly revealed that after 12 hours of perfusion time acropetal transport fell to levels less than 5 percent of the basipetal transport. (CWF)

<1309>

Vavilov, P.P., I.W. Verkhovskaya, O.W. Popova, and R.P. Kodaneva, Conditions of Radium Accumulation by Plants From the Soil. 1972. Part of Verkhovskaya, I.W. (Ed.), Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh, Izdatel'stvo Nauka, Moscow, USSR, (p. 95-103) (Not given)

The entry of radium into plants (bean, radish, sunflower, barley, spinach, salad) from soils with a high radium content (up to n. 10(E-7)) was investigated. The basic factor, determining the rate and extent of radium absorption from the soil, is intensive growth associated with an increase in vegetation mass. The magnitude of radium transfer from the soil into the overground part of the plants is determined mainly by their biological productivity. Species differences in the relative radium content in the zone of the overground mass were as a rule small, no

<1309> CONT.

greater than one order in the plants investigated. The entry of radium from the soil continues during the entire life of the plant. A slowing down of synthetic processes and rates of organ formations in plants has a limiting effect on the entry of radium. In leaves, the first period of life, associated with intensive increase in size, is characterized by a higher radium accumulation as compared with the period of stabilized leaf size. This fact proves that a relation exists between the age of the leaf and its radium accumulation. (Auth)

<1310>

Vazquez, B.M., and S.E. Bravo, Assessment of the Various Factors Governing the Siting of a Radioactive Waste Burial Ground for the Mexican National Nuclear Energy Commission. 1967. CONF-670512; STI/PUB-156; Part of Proceedings of the Joint IAEA/ENEA Symposium on the Disposal of Radioactive Wastes into the Ground held in Vienna, Austria, May 29-June 2, 1967, (p. 367-382) (Comision Nacional De Energia Nuclear, Mexico City, Mexico)

Various regions in the neighborhood of Mexico City were studied with a view to finding suitable sites for the installation of a radioactive waste burial ground. Each region was assessed from the viewpoints of lines of communications, rainfall, proximity to population centers, prevailing winds and their velocity, liability to earthquakes, sub-soil structure, fertility, and in general all the factors which might make it desirable or undesirable for habitation in the near future. Other important factors studied were the possibility of acquiring the sites, their size and proximity to common land which might be considered as affected, and certain legal aspects which might affect the land in the planning stage, such as rights of way, restrictions on use, and possible expressway construction. After assessment of the various technical, economic, administrative and legal aspects and consideration of the possible dispersal of radioactive elements into various media (atmosphere, water, soil, etc.), the sites most suitable for the radioactive waste burial ground were proposed, the conservation of natural resources and above all public safety being borne in mind. (Auth)

<1311>

Vecherkin, S.G., V.G. Bakhurov, and I.K. Lutsenko, Underground Leaching of Poor Uranium Ores. 1968, February. At. Energ. (USSR), 24, 128-133

A new method for the extraction of uranium from poor ores is described. The basic reason for which a sufficiently high quantity of uranium in poor ores is not used and is left, is the absence of profitable technology for their processing. An economic analysis showed that the special extraction and processing of these ores in hydrometallurgical plants or by means of leaching collectively and in pits is not profitable. The cost of leaching uranium can only be reduced by its leaching on the site of occurrence. Test operations were made in mines in which there were worked out ores and which were closed down although there remained large quantities of uranium in the ores. The studies made were used to determine their kinetic regularities and to work out a method and regime for industrial underground leaching. In this method an ore mass was decomposed by drilling. The ores are stored in blocks and sprinkled with solvent. The uranium-containing solutions, passing through

all stratum of ores, are accumulated at the bottom of the block and are led to the lower level, from where it is distributed by pumps to the surface for extended processing. The method of underground leaching makes it possible to conduct profitable processing of homogeneous and nonhomogeneous ores. (tr-Auth)

<1312>

Verkhovskaya, I.N., B.I. Gruzdev, V.I. Maslov, P.P. Vavilov, K.I. Maslova, V.S. Mikiyforov, V.J. Ovchenkov, O.N. Popova, and D.M. Rubtsov, Content and Translocation of Natural Radioactive Elements in the System Soil-Plants-Animals under Natural and Experimental Conditions. 1970. CONF-690918-(Vol. 2); Part of Proceedings of an International Symposium on Radioecology held in Cadarache, France, September 8-12, 1969, (p. 781-832), 684 p. (Institute of Biochemistry, Moscow, USSR; Commissariat a l'Energie Atomique, Centre d'Etude Nucleaires, Fontenay-aux-Roses, France)

The migration and distribution of natural radioactive elements in mountain-tundra and taiga biogeocenoses were studied. Radium is intensively absorbed by the plants of the families Rosaceae (SORBUS AUCUPARIA), Ericaceae (LEDUM DECUMBENS), Vacciniaceae (VACCINIUM MYRTILLUS, V. VITUS IDAEA, V. ULGINOSUM). Uranium is selectively absorbed by the sporophytes. Thorium has a low biological mobility and does not accumulate very much in plants. Animals play an important part in the transport of radioactive elements beyond the boundaries of sites with high natural radiation backgrounds. Not only do they accumulate radioactive elements in their organisms, but they displace huge masses of earth and spread them with their excrements over wide distances. In taiga biogeocenoses, the highest concentrations of radioactive elements are observed in mammals, especially in muriform rodents. (Auth)

<1313>

Vilenskii, V.D., Lead 210 and Radium 226 Distribution in Some Soils. 1969, December. Geokhimiya, 12, 1507-1510 (Institute of Geochemistry and Analytical Chemistry, Moscow, USSR)

Studies of lead 210 and radium 226 distribution in soil specimens taken from four vertical sections in two districts of European USSR territory, showed that (calculated as air-dry specimens) the Lead 210 content was within the range of approximately 0.1 to 7.7 nCi/g and Radium 226 was 0.1 to 2.2 nCi/g. In the lower levels the Lead 210 content in soil was identical to the Radium 226 content, while in the upper levels it exceeded the Radium 226 content. The higher Lead 210 content indicated that the actual fallout was within 6.5 to 42.3 nCi/m² per day with the mean of 22 nCi/m² per day. (NSA)

<1314>

Vlasis, J., and G.A. Pearson, Absorption of Radioactive Zirconium and Niobium by Plant Roots from Soils and its Theoretical Significance. 1950. Science, 111, 112-113 (University of California, Department of Soils, Berkeley, CA)

Organic acids appeared to be more effective than mineral acids in the extraction of zirconium and niobium from soil. Plants were capable of accumulating these radionuclides in leaf tissue. Various mechanisms responsible for plant uptake were considered. (CWF)

<1315>

Vogel, J.C., W.A. Casparie, and A.V. Munaut, Carbon 14 Trends in Subfossil Pine Stubs. 1969, November. Science, 166, 1143-1145 (University of Groningen, Groningen, Netherlands)

Subfossil pine stubs from a peat bog in the Netherlands were linked together dendrochronologically and sampled at intervals of 30 or 50 years for Carbon 14 analysis. The results suggest that the carbon 14 content of the atmosphere was not changing between about 5400 and 5100 B.C., but that it was increasing slightly about 800 years earlier. (Auth)

<1316>

Voilleque, P.G., D.R. Adams, and J.B. Echo, Transfer of Krypton 85 from Air to Grass. 1970, December. Health Physics, 19, 835 (Idaho Operations Office (AEC), Idaho Falls, ID)

An experiment was performed to determine the transfer velocity, $V_{sub d}$, for Kr 85 from air to grass ($V_{sub d}$ = Kr 85 transferred per unit horizontal area of grass/time-integrated air concentration) in a laboratory exposure chamber with 69 percent humidity and no wind simulation. $V_{sub d}$ for Kr 85 was found to be $2.3 \times 10^{(E-11)}$ cm/sec and was compared with $V_{sub d}$ for I 131 which was found to be 7.2 plus or minus 0.9 cm/sec measured under the same conditions. Reasons for the relatively high value of $V_{sub d}$ for I 131 were considered. As these were equally applicable to the Kr 85 measurement, it was believed that a value of $10^{(E-10)}$ cm/sec for $V_{sub d}$ (Kr 85) could be used as a conservative upper limit. (Auth)

<1317>

Volkova, M.Ya., G.I. Makhonina, and A.A. Titlyanova, Effect of Natural Extracts on the Sorption of Some Isotopes by Soil. 1964. Soviet Soil Science, 3, 266-270 (Academy of Sciences, Urals Branch, Institute of Biology, USSR)

A study was carried out of the desorbing properties of some natural extracts (water extracts from yellow leaves of aspen, birch, bird cherry, ferns, and pine needles) in respect to the following radioisotopes: Rb 86, Sr 90, Ru 106, Ag 110, Cd 115, and Ce 144. All the above elements increased their mobility under the influence of extracts. It is supposed that the desorbing effect of the extracts is connected with the formation of soluble complex compounds of the above metals with organic substances; the desorption effect of extracts on Rb and Sr depends upon the cations present in the extracts. (Auth)

<1318>

Vose, P.B., and H.V. Koontz, The Uptake of Strontium and Calcium from Soils by Grasses and Legumes and the Possible Significance in Relation to Strontium 90 Fallout. 1960. Hilgardia, 29, 575-585 (University College of Wales, Welsh Plant Breeding Station, Aberystwyth, Wales; University of California, Agricultural Experiment Station, Davis, CA)

Plant uptake data of strontium by legumes and grasses indicate that animals grazing mixed legume grass pastures will ingest greater amounts of strontium 90 in cases in which the legume dominates the forage as compared to grazing all-grass pasture. (CWF)

<1319>

Vose, P.B., and H.V. Koontz, Uptake of Strontium by Pasture Plants and Its Possible Significance in Relation to the Fallout of Strontium 90.

1959. Nature, 183, 1447-1448 (University College of Wales, Welsh Plant Breeding Station, Aberystwyth, Wales; University of California, Department of Agronomy, Davis, CA)

Authors advocated that in soils of relative high strontium 90 contamination, pastures used for milk production should be established with grasses rather than legumes followed by heavy nitrogen fertilization to avoid high radiostrontium concentrations in milk. (CWF)

<1320>

Voss, H.D., Survey of Environmental Radioactivity. IS-2025; 40 p. (Ames Laboratory, Ames, IA)

The environmental radiation monitoring program of the Ames Laboratory is described. The program consists of gross alpha and beta determinations of air, soil, vegetation, river water, Ames Laboratory Research Reactor (ALRR) outfall, bottom sediment, precipitation, well water, and pond samples. The ALRR reached full power as of July 12, 1967. A total of 26,297 megawatt hours was generated in 1968. The data indicate that the ALRR has not contributed a significant amount of radioactivity to the environment in the Ames area. The conclusion is reached that radioactivity levels recorded for environmental samples represent background conditions from atmospheric fallout and naturally occurring radioactivity. (Auth)

<1321>

Walker, J.B., Strontium Inhibition of Calcium Utilization by a Green Alga. 1956. Arch. Biochem. Biophys., 60, 264-265 (University of Texas, Biochemical Institute, Austin, TX)

Growth of the green alga, COCCOMYXA PRINGSHEIMII, was strongly inhibited by strontium. This inhibition occurred in the presence or absence of EDTA and with cells grown photosynthetically or photoheterotrophically. Results of cell growth curves (cell yield versus added calcium in the presence of various levels of strontium) supported the conclusion that strontium competitively inhibited the utilization of calcium required for growth of this species. (ST)

<1322>

Walker, J.B., Inorganic Requirements of CHLORELLA. I. Requirements of Calcium (or Strontium), Copper, and Molybdenum. 1953. Arch. Biochem. Biophys., 46, 1-11 (University of Texas, Biochemical Institute, Austin, TX)

Procedures are described for demonstrating requirements of the green alga, CHLORELLA PYRENOSIDA, for the inorganic micronutrients calcium (or strontium), copper, and molybdenum, in addition to the previously established requirements for iron, manganese, and zinc. Although the other micronutrient requirements are specific for the metal in question, the calcium requirement can be satisfied by strontium, on an approximately equimolar basis. (Auth)

<1323>

Walker, R.B., E.E. Held, and S.P. Gessel, Radiocesium in Plants Grown on Rongelap Atoll Soils. 1961. Part of Recent Advances in Botany, University of Toronto Press, Toronto, Canada, 1961, (p. 1363-7) (University of Washington, Seattle, WA)

<1323> CONT.

Tomato and squash plants were grown in greenhouse pot cultures using soil from Rongelap Atoll, which received fallout contamination in 1954. The treatments involved various combinations of N, P, and K. All fertilizer treatments markedly reduced the content of Cs 137 in the tissue. Also reported are the results of a field experiment on Rongelap Island in which fertilization with KCl at least temporarily reduced the content of Cs 137 in a native grass. Potassium and Cs 137 contents of foliar samples of several woody species collected on Rongelap Island are also included. In the most common pattern, K and Cs 137 contents of the upper foliage were higher than those of the lower leaves, but one species consistently showed higher K but lower Cs 137 in the upper foliage. Low K status of the soil and differences in mobility within the plant may explain these patterns. (Auth)

<1324>

Wallace, A., Monovalent-Ion Carrier Effects on Transport of Rubidium 86 and Cesium 137 into Bush Bean Plants. 1970. Plant and Soil, 32, 526-530 (University of California, Department of Agricultural Sciences, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

Bush bean plants were exposed to either Rb 86 or Cs 137 for 24 hours with different monovalent cations as carriers in single-salt solutions except for the presence of $10(E-4)M$ $CaCl_2$. Ratio of uptake of the radionuclides at $10(E-3)$ to $10(E-2)M$ was used as an index of the carrier ability of various cations. Different monovalent cations decreased uptake of Cs 137 and its transport to shoots unequally when $10(E-2)M$ salts were compared with $10(E-3)M$ salts. Rubidium and cesium salts decreased Cs 137 uptake when the ratios of the two concentrations were considered. All monovalent cations decreased uptake of Cs 137 at the $10(E-2)M$ carrier concentration but some did not at $10(E-3)M$. Nitrate nitrogen was a big factor in these results. Cesium and rubidium salts were most effective. Potassium appeared to increase Cs 137 transport to shoots particularly at $10(E-3)M$ KNO_3 . Only cesium, rubidium, and potassium salts decreased uptake of Rb 86 when $10(E-2)M$ salts were compared with $10(E-3)M$. Rubidium and cesium salts decreased uptake essentially equally and potassium salts again were less effective. All nitrate salts tended to increase Rb 86 transport to shoots more consistently than with Cs 137. It is concluded that absorption and transport to shoots were not equivalent for potassium, rubidium, and cesium. (Auth)

<1325>

Wallace, A., Effect of Calcium Levels on Redistribution of Strontium 85 in Bush Bean Plants. 1971. Plant and Soil, 35, 415-420 (University of California, Department of Soil Science and Agricultural Engineering, Riverside, CA; University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

When bush bean plants previously exposed to Sr 85 were transferred to solutions containing different levels of calcium without further addition of Sr 85, the calcium had relatively little, but some, effect on the redistribution of the Sr 85 in the plants. Calcium did tend to restrict movement of strontium. Sr 85 tended to concentrate in stems or old leaves, usually more so than calcium. New leaves particularly had lower Sr/Ca ratios than other plant parts indicating some discrimination in

favor of calcium. (Auth)

<1326>

Wallace, A., Phosphorus and Bicarbonate Effects on Strontium 85 Accumulation by Bush Beans. 1960. Soil Science Society of America Proceedings, 24, 327-328 (University of California, Department of Horticultural Science, Los Angeles, CA)

Increasing concentrations of bicarbonate and/or phosphorus decreased the top/root ratio of strontium 85 taken up from nutrient solutions. Such decreases were interpreted as reduction in translocation of strontium in the bush beans. (CNF)

<1327>

Wallace, A., Behavior of Certain Synthetic Chelating Agents in Soil and Biological Systems. 1969. UCLA-34-P-51-26; 92 p. (University of California, Los Angeles, CA)

A study is in progress of the elucidation of principles involved in the effects of synthetic chelating agents on behavior in plants of heavy metals (including micronutrients) and of radionuclides of heavy metals found in fallout. The behavior of most concern is the uptake from soil and distribution in plants of these radionuclides. Past studies have indicated that certain synthetic chelating agents correct micronutrient deficiencies in plants. Some increase the uptake only of the metal with which the agent is chelated, while others have a great influence on uptake and distribution in plants of other heavy metals and also of some radionuclides which may be in the soil as the result of fallout contamination. An elucidation of the principles involved will help to predict what could happen to many radionuclides. The additions of some iron chelates to soil in high levels induces deficiencies of other micronutrients such as manganese. Progress to date of studies of this behavior indicates that only some agents have this effect and that it is related to levels applied. Other chelating agents even when applied with iron increase the uptake of the very elements that the other agents cause deficiencies for. The principles of these reactions were studied in an effort to predict behavior for any agent. As part of a total study of chelating agents in soils and in biological systems the uptake and metabolism of the agents themselves were studied. Some attention was also directed towards the physiological effects of the metals themselves in plant nutrition. Interactions among metal and chelates, among different metals, and factors regulating the uptake of all are being considered. The chelating agents studied included DTPA, EDTA, EDDHA, ZnEDTA, ZnNTA, and AnSO (4). Data are reported on the effects of DTPA on the uptake of Am 241, Co 137, Fe 55, Pb 210, and Zn 65 by orange leaves immersed in solutions containing the radioisotopes; the effects of DTPA on the uptake of Am 241, Co 137, Hg 203, Pb 210, and Sb 125 by bush beans growing in two types of loam soil; and the effects of EDTA with the addition of Ca on the uptake of Cu 64 and Zn 65 by bush beans (PHASEOLUS VULGARIS). (NSA)

<1328>

Wallace, A., Effect of Citrus Rootstock and Chelating Agent on Specific Activities of Iron and Zinc in Shoots of Grafted Plants Following Iron 59 and Zinc 65 Application to Soil. 1971. CONF-711213; IAEA/SN-151/55; Part of Proceedings of a Symposium on the Use of Isotopes and

<1328> CONT.

Radiation in Research on Soil-Plant Relationships Including Applications in Forestry held in Vienna, Austria, December 13-17, 1971, (p. 1-8) (University of California, Agricultural Sciences, Soil Science and Agricultural Engineering, Los Angeles, CA)

Valencia orange scions were grafted to rough lemon or trifoliate orange rootstocks and grown with and without chelating agents in calcareous Hacienda loam soil to which high specific activity Fe 59 and Zn 65 had been mixed. Mineral analyses were determined after 85 days in leaves and stems of suckers growing from the rootstocks and also in new and old leaves and stems of the scions after 119 days. The chelating agents had little effect on iron contents of the plants, but they increased considerably the specific activities of the iron in the shoots. RA 157 increased them more than did DTPA and the effects were much more pronounced with rough lemon rootstock than with trifoliate orange. It did not consistently increase zinc content, but DTPA did. DTPA increased specific activities of the zinc, but RA 157 did not. Specific activities of both iron and zinc were higher for rough lemon than for trifoliate orange. (Auth)

<1329>

Wallace, A., Effect of Soil pH and Chelating Agent (DTPA) on Uptake by and Distribution of Americium 241 in Plant Parts of Bush Beans. 1972. Radiation Botany, 12, 433-435 (University of California, Riverside, CA)

Bush bean (PHASEOLUS VULGARIS L. var. Improved Tendergreen) plants were grown with and without the chelating agent diethylenetriaminepentaacetate (DTPA) in Yolo loam soil, which was amended to give a range of soil pH values. A level of 1.68 μCi Am 241 was uniformly mixed with each 500 g quantity of soil. Highest amounts of Am 241 and highest leaf-stem ratios for the Am 241 were found in plant parts at soil pH around 7.7 with the DTPA. The results are interpreted as chelated Am 241 not only being available to the plants especially at pH 7.7 but also the Am 241 being transported through the plants as the metal chelate. (Auth)

<1330>

Wallace, A., Retranslocation of Rubidium 86, Cesium 137, and Potassium to New Leaf Growth in Bush Beans. 1968. Plant and Soil, 29, 184-187 (University of California, School of Medicine, Department of Biophysics, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

Bush bean plants were exposed to either Rubidium 86 or Cesium 137 with and without carrier rubidium or cesium for 48 hours in a complete nutrient solution. These solutions were then discarded. The plants were then allowed to grow for 111 additional days in complete nutrient solution except that potassium was omitted. Measurement of Rb 86, Cs 137, and potassium in new leaves indicated that Cs 137 was retranslocated to the new growth much slower than was potassium but that proportionately more Rb 86 was in new leaves than potassium and these results were independent of the presence or absence of the respective carriers. Considerably more Rb 86 than Cs 137 was absorbed by the plants either with or without the carriers. (Auth)

<1331>

Wallace, A., V.Q. Hale, and C.B. Joven, DTPA and

pH Effects on Leaf Uptake of Iron 59, Zinc 65, Cesium 137, Americium 241, and Lead 210. 1969. Journal American Society Hort. Sci., 94, 684-686 (University of California, Los Angeles, CA)

"Washington Navel" orange leaves were immersed in solutions containing the radionuclides Fe 59, Zn 65, Cs 137, Am 241, and Pb 210 with and without the chelating agent DTPA (10(E-4)M), at pH varying from 2.0 to 8.0 and with and without the respective stable nuclides as carriers (10(E-4)M) except for Am 241. Low pH decreased the uptake of all five radionuclides. Without carrier the uptake of Zn 65 increased with pH up to pH 8.0 as did uptake of Am 241. The addition of carriers decreased uptake of all five radionuclides but carrier effect was least on Cs 137. DTPA largely negated the effects of pH on uptake and greatly depressed uptake. (Auth)

<1332>

Wallace, A., and R.T. Mueller, Effect of Chelating Agents on the Availability to Plants of Carrier-Free Iron 65 and Zinc 59 Added to Soils to Simulate Contamination from Fallout. 1969. Soil Science Society of America Proceedings, 33, 912-914 (University of California, Department of Agricultural Sciences, Los Angeles, CA)

Carrier-free Fe 59 and Zn 65 were added to Dinuba fine sandy loam (neutral), Hacienda loam (calcareous), and Yolo loam (slightly acid), and equilibrated through drying and wetting cycles. Bush bean (PHASEOLUS VULGARIS L., var. 'Improved Tendergreen'), corn (ZEA MAYS L., var. 'Golden Cross Bantam'), and soybean (GLYCINE MAX Merr., var. 'PI-54619-5-1' and 'hawkeye') were grown in Fe 59-containing soil and bush bean (P. VULGARIS L.), corn (Z. MAYS L.) and cotton (GOSYPHIUM HIRSUTUM L., var. 'Acala 442') were grown in Zn 65-containing soil. One-half of those with Fe 59 received Na2EDDA equivalent to 4.4 kg of Fe/ha had there been a 1:1 metal chelate and one-half of those with Zn 65 received Na2EDTA equivalent to 5.5 kg of Zn/ha had metal been added with the chelating agent. The chelating agents had many different effects depending on soil and on crop. Chelating agents increased the specific activity of Fe 59 in the bush bean and soybeans. The specific activity of Fe 59 in corn was unchanged by chelating agent but was much higher than in bush bean and soybean with or without chelating agents. When carrier Fe was added, the behavior of Fe 59 was essentially unchanged. The specific activity of Zn 65 in plants in most cases was increased by the EDTA. The EDTA increased both Zn 65 and total Zn in corn, but the specific activity generally was unchanged by the chelate. (Auth)

<1333>

Wallace, A., and E.M. Rooney, Some Interactions of Calcium, Strontium, and Barium in Plants. 1971. Agronomy Journal, 63, 245-248 (University of California, Department of Agricultural Sciences, Los Angeles, CA)

Short-term uptake tests (48 hr) disclosed that increasing levels of Ca in solution cultures decreased both Sr and Ba uptake by bush beans and decreased the proportions of them remaining in roots compared with that transported to leaves. Barium uptake was greater than Sr, and the concentration of both of these elements was highest in roots and lowest in leaves. Calcium accumulation was highest in stems and lowest in leaves. Uptake of Sr and Ba by roots showed little temperature dependency, but long-distance

<1333> CONT.

transport to shoots was temperature dependent as is known for Ca. Strontium and Ca and also Ba to a lesser extent served as stable-element carriers for transport of Sr 85 isotope into bush beans, but Mg did not. A level of $10(E-2)$ M Ba in nutrient solution was toxic to the plants: that which was transferred to shoots killed the leaves. Its effect on permeability resulted in large transfer of Sr 85 to shoots. Long-term uptake tests (90 days) with tobacco grown in solution culture disclosed that Ca accumulated more in leaves while Sr and Ba accumulated more in roots. Two desert-plant species, *LYCIUM ANDERSONII* and *LYCIUM PALLIDUM*, showed interesting differences in their accumulation of these elements. *L. ANDERSONII* tended to concentrate Ca in leaves, but Ba was concentrated in roots with Sr equally divided between roots and leaves. *L. PALLIDUM* concentrated all three of these cations more in roots than in leaves. (Auth)

<1334>

Wallace, A., et al, Effect of Citrus Rootstock and Chelating Agent on Specific Activity of Iron and Zinc in Shoots of Grafted Plants and on Iron 59, Zinc 65, Lead 210, and Americium 241 Contents in the Shoots. 1971. UCLA-34-P-51-33; Part of Wallace, A., et al, Regulation of the Micronutrient Status of Plants by Chelating Agents and Other Factors, (p. 168-172), 309 p. (University of California, Los Angeles, CA)

Valencia orange scions were grafted to rough lemon or trifoliolate orange rootstocks and grown for 119 days with and without chelating agents in calcareous Hacienda loam soil to which high specific activity iron 59, zinc 65, lead 210 or americium 241 had been mixed. Mineral analyses were determined after 85 days in leaves and stems of suckers growing from the rootstocks and also in new and old leaves and stems of the scions after 119 days. The chelating agents had little effect on iron content of the plants but they increased considerably the specific activity of the iron in the shoots. Ra 157 increased it more than did DTPA and the effects were much more pronounced with rough lemon rootstock than with trifoliolate orange. DTPA increased the zinc 65 contents but with rough lemon more so than with trifoliolate orange. It did not consistently increase zinc content. No effects were noted for contents of lead 210 in shoots: virtually none was present. DTPA did increase the contents of americium 241 in the shoots of both rootstock-scion combinations. (Auth)

<1335>

Wallace, A., et al, Effects of Micronutrient and DTPA Applications on Americium 241 And Micronutrient Contents of PI54619-5-1 Soybeans Grown in Calcareous Hacienda loam Soil. 1971. UCLA-34-P-51-33; Part of Wallace, A., et al, Regulation of the Micronutrient Status of Plants by Chelating Agents and Other Factors, (p. 8-9), 309 p. (University of California, Los Angeles, CA)

PI54619-5-1 soybeans which are susceptible to lime-induced chlorosis were grown in calcareous Hacienda loam soil with micronutrient and chelate additions. Americium 241 which had been mixed with the soil was greatly increased in plants to which iron DTPA had been added to the soil. Application of high levels of zinc or manganese decreased Americium 241 content of plants only slightly. The FeDTPA was of slight value only in correcting the lime-induced chlorosis. The 4 pounds per acre

of iron as DTPA increased zinc contents of leaves as much as did 100 pounds per acre of added zinc. Manganese increased manganese contents of leaves; 200 pounds manganese per acre doubled the manganese content. (Auth)

<1336>

Wallace, A., et al, Retranslocation of Americium 241 in Bush Beans. 1971. UCLA-34-P-51-33; Part of Wallace, A., et al, Regulation of the Micronutrient Status of Plants by Chelating Agents and Other Factors, (p. 96-97), 309 p. (University of California, Los Angeles, CA)

americium 241 initially after absorption was largely located in leaves of plants. During a subsequent growth period some of the americium 241 was transported from the old leaves to the new leaves and to new roots. The chelating agent DTPA had no effect on the retranslocation. Since the chelating agent DTPA has been shown to increase americium 241 uptake by plants this study was made to determine if DTPA had any effect on retranslocation of americium 241 once it was accumulated in plants. Plants were allowed to accumulate americium 241 and then the americium 241 was removed and plants allowed to grow to maturity with and without DTPA. The results have implications on the absorption of and behavior of chelating agents in plants. (Auth)

<1337>

Waller, H.D., and J.S. Olson, Prompt Transfers of Cesium 137 to the Soils of a Tagged *LIRIODENDRON* Forest. 1967. Ecology, 48, 15-25 (Oak Ridge National Laboratory, Health Physics Division, Radiation Ecology Section, Oak Ridge, TN)

An inventory of total Cesium 137 distribution in a 500-m² tagged tulip poplar (*LIRIODENDRON TULIPIFERA*) forest at the Oak Ridge National Laboratory showed transfer from trees to soil during the first growing season. About one-third of the maximum amount of radiocesium found in the tree canopy during June was transferred to the forest floor and soil; the remainder moved back into woody tissue (stem and roots) before leaf fall. Losses of radiocesium from the foliage and stems into the plot area through litterfall (55 uc/m²) and rain leaching (13 uc/m²) accounted for almost 8% (68 cu/m²) of total Cs 137 (934 uc/m²) introduced into three holes. However, soil (including roots) and litter sampling at the end of the growing season, indicated a much larger quantity (414 uc/m² or 45% of initial input) already in the surface 30-cm layer of mineral soil. Of the total Cs 137 activity found within the mineral soil layer, about half can be physically associated with the tagged trees through removal of roots from soil samples and cumulative measurement of surface income at time of soil collection. Much of the remainder can be accounted for by contact exchange, root death, and leaching of roots by soil solution. (Auth)

<1338>

Walter-Levy, L., and E. Strauss, The Absorption of Strontium by *CHARA FRAGILIS* Desvieux. 1968. Compt. Rend., Ser. D, 266, 1486-1489 (University, Faculte Des Sciences, Caen, France; University, Faculte Des Sciences, Dijon, France)

The absorption by *CHARA FRAGILIS* Desvieux of strontium introduced into the culture medium was studied by examination of the dry thallus by radiocrystallography and the determination of the alkaline earths in the plant ashes. The chemical analysis showed in all cases an

<1338>

<1338> CONT.

absorption of Sr by the thallus. The Sr, which can attain a concentration of 24% of the dry matter, increased as a function of the concentration of the element in the external medium. The percentage of Sr was higher in the young axes than in the trunk plant. The sum of the Sr and Ca ions had little variation. The radiograms show the presence of calcite and of two solid solutions of calcium and strontium carbonate, the first rhombohedral of the calcite type and the second orthorhombic of the aragonite and strontianite type. The data showed that in Sr-enriched medium, CHARA FRAGILIS absorbed Sr principally in the form of mixed crystals belonging to the orthorhombic system. (NSA)

<1339>

Walton, A., The Distribution in Soils of Radioactivity from Weapons Tests. 1963. J. Geophys. Res., 68, 1485-1496 (Isotopes, Incorporated, Westwood, NJ)

Results of the vertical profiles of radioactivity from weapons tests in several soils from New Jersey are presented. Four radionuclides, strontium 90, ruthenium 106, cesium 137, and cerium 144, were examined, and in general the cumulative activities agreed with the quantities estimated from the observed concentrations of the nuclides in precipitation. Vertical distributions of radioactivity within soils appear to vary considerably, and in many instances they can be correlated with certain physical parameters. Permeability and drainage characteristics of the soil and underlying strata are rather important factors in this respect. Strontium 90, a nuclide of particular interest, was distributed on the average with 55 per cent of the total deposit in the top 2 inches, 79 per cent in the top 4 inches, and about 96 per cent in the top 9 inches in 1960. As expected, strontium 90 appears to have penetrated to greater depths than cesium 137. The combined activities of the three nuclides yielded a dose rate in 1960 of less than 3 percent of the maximum external dose rate recommended by the National Committee on Radiation Protection for the general populace. (Auth)

<1340>

Ward, G.M., J.E. Johnson, and D.W. Wilson, Food Chain Transfer of Cesium 137 from Troposphere to Man, Summary Report. 1969. COO-1171-103; 21 p. (Colorado State University, Department of Animal Science, Fort Collins, CO)

Results to date are presented from a series of investigations to determine the transfer of Cs 137 through food chains from the troposphere to man. Four separate lines of investigation were conducted. Results of current studies to predict the fallout rate and crop contamination by surface air levels strongly suggest that dry fallout was the primary means of contamination of fallout Cs 137 in forages in the study area. A simplified model to predict milk concentrations of fallout Cs 137 from surface air concentrations was developed. Investigation of the importance of soil concentrations of fallout Cs 137 revealed that, owing to the high percentages of clay minerals in the local soils, direct foliar fallout deposition was more important than direct soil uptake by forages and grains which was negligible. In an investigation of the transfer of fallout Cs 137 from forages and grains to milk and meat, it was found that forages are the prime source of uptake of Cs 137 in dairy and beef cattle. The transfer of

fallout Cs 137 from feed to milk and meat was described by parameters termed milk transfer coefficient and meat transfer coefficient respectively. The importance of meat and milk and other dietary constituents on the transfer of fallout Cs 137 to man was also investigated. Measurements were made of the Cs 137 intake of several families from all dietary sources and body burdens were measured monthly. Knowledge of the rate of change of intake made it possible to calculate the retention half-times for each individual. Knowing this parameter aids in the prediction of human doses. A brief discussion is included of all experimental work carried out during 1968 to 1969. (NSA)

<1341>

Ward, G.M., D.W. Wilson, and J.E. Johnson, Food Chain Transfer of Cesium 137 from Troposphere to Man, Sixth Annual Report. 1968. COO-1171-82; 106 p. (Colorado State University, Department of Animal Science, Fort Collins, CO)

Atmosphere and atmospheric precipitation in Colorado were analyzed for Cs 137 from fallout in 1967. Studies on contamination of feed by fallout include analyses of dairy feeds for Ce 144, Cs 137, K 40, Mn 54, Ru 106, Sb 125, and Zr 95. Milk samples from the University dairy herd were analyzed for Cs 137 and K during the period from 1962 to 1967. Analysis of human diet for Cs 137 included determinations on cereals, fruits, meats, and milk. Monthly levels of Cs 137 were determined in man by whole-body counting. Rates of decrease of body burden were determined using the food level decay constant, daily intake, and biological decay time. The fission products, Ce 144, Mn 54, Ru 106, and Sb 125, were determined in surface air by gamma ray analysis during the period from 1962 to 1967. Peak values for all radionuclide activities in air in the five yr time span occurred in the spring of 1963, and levels decreased exponentially from the 1963 peaks. A mathematical model for predicting fallout Cs 137 in milk was constructed. Factors considered in formulation of the model were description of fallout rate to crops, feeding practices that determine intake, and the transfer from feed to milk. Monthly averages of Cs 137 were determined between 1962 and 1967, and the time trends of these levels were analyzed into two components, one describing the buildup of surface air levels that occurred during the fall and winter, and another describing the decrease of surface air levels through spring and summer. The mean half-time for the buildup in surface air was 80 days, while the mean exponential half-time of decay in the second period was 45 days. Deposition velocities for radon daughters on alfalfa were determined and results are tabulated together with wind speed and relative humidity. Calibration of the whole-body counter was done for humans for Cs 137 and K 42. Effects of age, height, and weight on results are shown by means of a table. Potassium 40 was used as an indicator for determinations of body composition of cattle and swine. The milk secretion rate of Cs 134 was investigated in a lactating cow following an acute ruminal dose of tracer when the cow was in equilibrium with three diets of differing K content. In order to provide data for comparison of turnover rates of Cs 134 between species the rate constants for turnover of Cs in a sheep were investigated. Determinations of whole-body Cs 137 and K were made on members of the Colorado State University girls swimming team. Body burdens of Ra 226, RaB, and RaC were determined for a human subject using the Colorado State

<1341> CONT.

University counter. Standard chair human geometry was calibrated for Ra 226. The rate of release of the major nutritional cations from feed, Na^+ , K^+ , Ca^{++} , and Mg^{++} was determined in water solution. The studies were carried out by placing alfalfa samples in a container with water and sampling the solution every five min over a 90 min interval. There was a rapid burst of these ions from feed over the first five min of water extraction followed by a somewhat slower release over the next 90 min. Effects of K on cation balance and metabolic rate in rats were determined. The effects of rubidium on K metabolism in chicks were studied. Experiments on the availability of radiocesium from alfalfa hay showed that Cs 134 in plants was readily solubilized by treatment with acid intergent fiber solvent, while fallout Cs 137 was related to the degree of solubility. The relationship of K to body composition was determined in cattle, hogs, rabbits, rats, and sheep. These determinations are necessary for the use of whole-body counters. Computer programs, after accepting information on choice of crystal, energy ranges, counting geometry, and other factors, sum the counts in appropriate energy regions, allow for Compton contributions, apply the calibration factor, and compute a result that is then presented in tabular form. A list of 34 publications and manuscripts prepared during the year is included. (NSA)

<1342>

Watters, R.L., and W.R. Hansen, Hazards Implication of the Transfer of Unsupported Polonium 210 from Alkaline Soil to Plants. 1970, April. Health Physics, 18, 409-413 (Colorado State University, Fort Collins, CO)

A study of plants grown in Po 210 PoO₂ contaminated alkaline Brown soil indicated a small but definite uptake through the root system. The concentration in various tissues varied with species and growing time. A hazards analysis revealed that a surface concentration of 3.1×10 (E-3) Ci/m² on an agricultural area composed of an alkaline Brown soil could produce a radiological health problem for more than one year because of root uptake in edible vegetables. (Auth)

<1343>

Watters, R.L., and J.E. Johnson, Study of Unsupported Polonium 210 for Ion Exchange in Soils and Uptake in Vegetation, Third Technical Progress Report, August 15, 1969 - May 1, 1970. 1970, May. COO-1733-9: 79 p. (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO)

Mechanisms involved in the translocation of Po 210 from soil to edible plants were studied for various soil types and conditions. The natural Po 210 content of 11 topsoils and seven profiles found in the U.S.A. and Puerto Rico was determined. Results indicated that soil type influences the Po 210 content. The effects of rainfall on the uptake of Po 210 by agricultural plants from various soil types were investigated in greenhouse studies. (NSA)

<1344>

Watters, R.L., and J.E. Johnson, A Study of Unsupported Polonium 210 for Ion Exchange in Soil and Uptake in Vegetation, Second Technical Progress Report, August 15, 1968 - May 1, 1969. 1969, May. COO-1733-3: 67p. (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO)

Accidental rupture or burn-up of a Po 210 fueled radioisotope generator could result in contamination of the soils of an agricultural area. The Po 210 released from an accident would be in an oxide form. Reported data indicate that plants grown in polonium chloride contaminated soil do contain measurable amounts of polonium. To study plant uptake of polonium introduced into the soil as an oxide, vegetables were grown from seed to maturity under greenhouse conditions in soils contaminated with 0.5 to 2.0 nCi/g of soil. The vegetables studied were barley, celery, corn, onion, pea, potato, radish, spinach, tomato and wheat. Stems, leaves, fruits, roots, or tubers from each plant type were analyzed for Po 210 in terms of dpm/g dry-weight of control plants and in percent translocation of the polonium from soil to plant. The polonium content of plants grown in a calcareous soil ranged from 0.001 to 0.7 percent of the polonium in the soil. The leafy and stem portion of plants contained most of the polonium with fruits and seeds containing the least. (Auth)

<1345>

Watters, R.L., and J.E. Johnson, A Study of Unsupported Polonium 210 for Ion Exchange in Soil and Uptake in Vegetation, First Technical Progress Report, August 15, 1967-May 1, 1968. 1968, May. COO-1733-1: 27p. (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO)

Equilibrium distribution coefficients for Po 210 between Colorado soil horizons and aqueous solutions and the polonium uptake of edible vegetables from a Brown soil of known Po 210 content were determined. Experimental procedures and analytical techniques that were used are described. A list of proposed publications and papers and descriptions of the Munn Silty Clay Loam and Darling soils are presented. (NSA)

<1346>

Watters, R.L., and J.E. Johnson, Study of Unsupported Polonium 210 for Ion Exchange in Soils and Uptake in Vegetation, Summary Report, 1974 - 1972. 1972. COO-1733-14: 109 p. (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO)

Studies conducted during 1967 to 1972 on the fate of Po 210 deposited in watersheds and agricultural areas are summarized. Results and conclusions are presented for the following studies: distribution coefficients of Po 210 for soil profiles of red-yellow podzols, ground water podzols, and lateritic soil; movement of Po 210 in contaminated soil under the influence of water percolation; use of electrophoresis and dialysis to characterize chemical species of Po 210 in soil; natural Po 210 concentration in soils and plants; uptake by plants of unsupported polonium from soils contaminated with Po 210 dioxide; foliar absorption of Po 210 from Po 210 dioxide contaminations; and characterization of Po 210 species in plant tissue. Recent studies on the microdistribution of Polonium in plants included the effects of Ca, S, P, and N nutrient deficiencies on the Po dioxide accumulation in barley, corn, oats, and radishes; ultracentrifugation separation of polonium-containing subcellular particles; and amino acid analysis of ASTRAGALUS OSTERHOFFII grown in soil containing polonium oxide. (NSA)

<1347>

<1347>

Watters, R.L., and J.F. McInroy, The Transfer of Polonium 210 from Cattle Feed to Milk. 1969. Health Physics, 16, 221-225 (Colorado State University, Fort Collins, CO)

Polonium 210 has been proposed for use in radionuclide electrical generators in space missions. Accidental release of the quantities of this material required for such an application could lead to the contamination of large areas. One of the hazards of such an accident could be the transfer of Po 210 from contaminated dairy pasture to man through the milk supply. A study is described in an attempt to estimate the magnitude of this problem from a Po 210 acute ingestion experiment with one Holstein cow. With the use of assumptions regarding the feeding of cattle and the intake of milk by man an estimate of the surface deposition to produce a maximum permissible body burden is made. (Auth) (NSA)

<1348>

Wells, B.R., and E.R. Graham, Direct Radioactive Assay of Cation Retention by Mineral and Organic Colloids. 1965. Soil Science, 100, 10-13 (University of Missouri, Columbia, MO)

The direct measurement of cations retained by clay revealed the following items of importance. Reproducible results are obtainable with the direct methods. A sensitivity of plus or minus 1 me./100 grams is possible with milligram quantities of clay. The results obtained with kaolin clay when sodium and cesium were the saturating ions indicated that the attraction by kaolin for Na and Cs was lower than that observed for the other systems. The illite clay revealed no measurable differences in the retention of Na and Cs with change in pH. The differences observed with Sr and Zn were slight. Zn was adsorbed by all colloidal systems even in the presence of high hydrogen saturation. To obtain reproducible results for the cation-exchange capacity, the control of the suspension pH and use of a strontium salt containing Sr 85 is suggested. (Auth)

<1349>

Welsh, W.J., and E.R. Samuels, Radiation Protection Division Results in the 1964 Interlaboratory Comparison Program of the International Atomic Energy Agency. Not given. NP-16900; IAEA Radiation Protection Division Report No. 53, (p. 14-27) (Canada Department of National Health and Welfare, Ottawa, Ontario, Canada)

The results of a 1964 and 1965 interlaboratory study conducted by the IAEA to determine the Cs 137 and Sr 90 content in meat ash, fish meal, and powdered milk, and the Sr 90 content in bone ash, rice flour, and soil are presented. (NSA)

<1350>

Welte, V.E., A. Klicke, and U. Marckwort, Studies on the Lessening of the Strontium Uptake of Plants from the Soil. 1961. Atompraxis, 7, 3-7 (Institut für Nichtparasitäre Pflanzenkrankheiten, Biologische Bundesanstalt für Land und Forstwirtschaft Berlin-Dahlem, German)

Pot and aqueous-culture tests with inactive strontium were used to show that lime and magnesium fertilizers lessen the uptake of Sr 90 only in soils with extremely small calcium contents. (tr-Auth)

<1351>

Wendt, I., W. Stahl, M. Geyh, and P. Pauth, Model Experiments for Carbon 14 Water-Age Determinations. 1967. CONF-661133; STI/PUB-141; Part of Proceedings of a Conference on Isotopes in Hydrology held in Vienna, Austria, November 14-18, 1966, (p. 321-337), 740 p. (Bundesanstalt für Bodenforschung, Hanover, German Federal Republic)

The C 14 age of water samples is calculated by assuming that fossil carbonate is dissolved by biogenic CO₂ according to the equation, $X \text{ sub } 1 \times \text{CaCO}_3 \text{ sub } 3 + (X \text{ sub } 1 + Y) \times \text{CO}_2 \text{ sub } 2 + \text{H}_2\text{O} = 2X \text{ sub } 1 \times \text{HCCO}_3 \text{ sub } 3 + Y \text{ sub } 1 \times \text{CO}_2$, where X and Y are the number of moles of the two carbon components before and after the dissolution process. In a closed system the relation, $Y \text{ sub } 1 = K(T)$, which depends on the temperature, controls the concentrations of free CO₂ and HCO₃. To investigate the mechanism of the dissolution, laboratory experiments under controlled conditions were carried out. Non-radioactive CaCO₃ sub 3, which had a delta C 13 value of +30 percent, and radioactive CO₂ with delta C 13 = -22 percent were used. The purpose of these investigations was to check the validity of theoretical assumptions regarding the average C 14 activity and the delta C 13 value of the total carbon which is dissolved as CO₂, and HCO₃. Furthermore, it was investigated whether, within the duration of the experiment, a possible exchange takes place between the undissolved carbon present in the CaCO₃ and that present in the HCO₃. The importance of this lies in the fact that the method of C 14 age determination is based on the assumption that such an exchange does not take place. The experiments which have been performed up to now show that in case of the simple CaCO₃-CO₂ system, which has been considered first, this assumption is not justified even for a constant water temperature. If variations in the water temperature occur during the history of the water sample, precipitation and redissolution processes influence the C 14 and delta C 13 values differently. This is due to isotopic fractionation processes between the HCO₃ and CO₂ phase. A correction for the initial C 14 activity by means of the delta C 13 value is no longer possible, and the reliability of the C 14 dating method becomes questionable. (Auth)

<1352>

Whicker, F.W., C.A. Little, and T.F. Winsor, Plutonium Behavior in the Terrestrial Environs of the Rocky Flats Installation. 1973. CONF-731117; Part of Proceedings of an IAEA Symposium on Environmental Surveillance around Nuclear Installations held in Warsaw, Poland, November 5-9, 1973 (Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO)

Environmental surveillance for plutonium around a plutonium processing plant is described. Plutonium concentrations in soils, vegetation and mammals are presented. Soil serves as the principal plutonium reservoir. (CWF)

<1353>

Whitehead, W.E., B.B. Brooks, and P.J. Peterson, Nature of Uranium Occurrence in the Leaves of COPROSHA AUSTRALIS (A. Rich.) Robinson. 1971. Aust. J. Biol. Sci., 24, 67-73 (Massey University, Palmerston North, New Zealand)

The distribution and chemical form of uranium

<1353> CONT.

was investigated in leaves collected from plants of *C. australis* (Rubiaceae) growing in a mineralized soil in the Fuller Gorge, New Zealand. Only small amounts of uranium (< 10 percent) were found in a low molecular weight form. The predominant occurrence of uranium (65 percent) was as a uranium - RNA complex, which was isolated by high-voltage electrophoresis from an aqueous extract of the freeze-dried leaves. Uranium (25 percent) was released from the solvent extracted leaf residue by pepsin, thus revealing the presence of a uranium-protein complex. However, in view of the known dissociation constants for these two complexes, and other tests, it is clear that the majority of the uranium *in vivo* is in the form of a uranium-protein complex. This finding is confirmed by a differential centrifugation experiment, in which it was shown that at least 50 percent of the total uranium was bound to cell wall proteins. (Auth)

<1354>

Whitford, P.B., Foliar Application of Cesium 137 on Understory Species of Mesic Forest. 1968, December. *Radiation Botany*, 8, 509-513 (University of Wisconsin, Milwaukee, WI)

Foliar application to the understory in a Liriodendron forest of 35 $\mu\text{Ci}/\text{m}^2$ of Cs 137 diluted in 11 m^2 water showed 18 percent retention of the isotope on foliage after 2 hr, 9, 8, and 7 percent after 2, 4, and 6 weeks (the major part of the applied solution dripped on to the litter layer). Approximately 22 cm of rain during the test period accounted for most of the reduction in isotope in the foliage, as well as for transfer through the litter to the top 5 cm of soil (23 per cent of application) by the end of the sixth week. Less than 4 percent was absorbed and translocated to stem and roots. Differences between species are probably related to leaf surface structure, mass/area ratio, and leaf orientation. (Auth)

<1355>

Wiebe, H.H., and P.J. Kramer, Translocation of Radioactive Isotopes from Various Regions of Roots of Barley Seedlings. 1954. *Plant Physiology*, 29, 342-348 (Duke University, Department of Botany, Durham, NC)

The translocation of radioactive isotopes from various regions of the root was studied in attached roots of barley seedling. The isotopes used were P 32, S 35, Ca 45, Rb 86, I 131, and Sr 90. Absorption cells were developed by which the isotope solution could be supplied to any 3 mm region of a root while the remainder of that root and the other roots of the seedling were kept in nonradioactive nutrient solution. The absorption cells were attached at the tip, about 10 mm, 20 to 30 mm, and 55 to 70 mm behind the tip. Although the tips absorbed the various ions freely, very little upward translocation of any of them occurred from the terminal 5 mm region of the roots. Greatest translocation occurred from the region 30 mm back of the root tip. Translocation from the region more than 50 mm above the tip was somewhat lower, but much greater than from the apical region. Upward translocation of Ca and Sr was very limited. All isotopes moved downward in the treated roots. P 32 and S 35 moved down to the tips of the roots and accumulated there. Rb 86, Ca 45, Sr 90, and I 131 moved down also, but stopped several mm short of the root tips. The results of these experiments suggest that most translocation of minerals to the shoots

occurs from a region of the roots several cm behind the root tips. This seems to coincide approximately with the region of maximum water absorption. (Auth)

<1356>

Wiklander, L., Uptake, Adsorption and Leaching of Radiostrontium in a Lysimeter Experiment. 1964. *Soil Science*, 97, 168-172 (Royal Agricultural College, Uppsala, Sweden)

The lysimeter experiment was started in 1957 with an acid soil (pH=4.5). By liming and potassium fertilization, four different treatments were arranged. In 1958 50 μCi Sr 90, as SrCl_2 , was added to the surface soil with the object of studying (a) the translocation of Sr into the underlying soil, (b) the distribution between exchangeable and nonexchangeable forms, (c) the loss of Sr by leaching, and (d) the uptake of Sr by crops during 1959-1962, all as affected by liming and potassium fertilization. Liming retards the translocation of Sr from the surface soil to the subsoil in accordance with the theory. In the unlimed soils 32 per cent of the Sr was found below a depth of 15 cm. and in the limed soils only 11.0 percent. Potassium fertilization, on the other hand, somewhat increased the downward movement of Sr. Ten to 12 percent of Sr retained by the soil was transformed into nonexchangeable form. The loss of Sr by leaching during 1958-1962 was very small (about 1.2 percent of added Sr) and showed no significant influence of liming, which was due to the same composition of subsoil. Liming, strongly reduced the uptake of Sr by plants, the decrease being 40 to 45 percent. Four successive crops together took up 4.5 to 9.2 percent of added Sr. Red clover took up around 7 to 9 times as much as wheat and barley; in one red clover crop on unlimed soil not less than 5.0 per cent of the added Sr was absorbed. Of the Sr taken up by barley 3.9 percent was found in the seed and 96.1 percent in the straw. Potassium fertilization decreased the Sr uptake by red clover but not that by barley and not significantly that by wheat. (Auth)

<1357>

Williams, J.E., Biological Transport of Zinc 65 in a South Carolina Broomsedge Field. CONF-670503; (p. 665-671) (University of Georgia, Athens, GA)

Dispersion of Zn 65 in a South Carolina broomsedge field from labeled litter in mesh bags was primarily by biological transport via plant roots. Concentrations of isotope were found in plants up to 50 cm away from mesh bags, whereas leaching and other factors moved Zn 65 less than a third that distance (15 cm). Zinc 65 was concentrated in plant shoots, whereas comparatively little isotope was found in roots. Labeled materials were placed in the field in July 1965, but no isotope was found in plants until April 1966. No Zn 65 was detected in arthropods. (Auth)

<1358>

Willis, C.P., D.G. Olson, and C.W. Sill, Radiochemical Determination of Sulfur 35 in Large Samples of Vegetation. 1970, January. *Anal. Chem.*, 42, 124-126 (Idaho Operations Office (AEC), Idaho Falls, ID)

A method is described for the determination of S 35 in green alfalfa by liquid scintillation counting. The method involves the decomposition of 30/g samples of alfalfa by wet-ashing with less than a 4 percent loss of

<1358> CONT.

the S. Twelve samples can be decomposed at a time by one operator in less than 2 hr. The counting efficiency for S 35 was estimated from a certified C 14 standard. An overall recovery of 93 percent or better was obtained routinely by means of this procedure. (NSA)

<1359>

Wilson, D.O., and J.F. Cline, Removal of Plutonium 239, Tungsten 185 and Lead 210 from Soils. 1966, February. Nature, 209, 941-942; HW-80500; (p. 187-190) (Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA; Hanford Atomic Products Operation, Richland, WA)

The plant-soil interrelationship of Pb 210, W 135, and Pu 239 was investigated. The amounts of these radioisotopes removed from different soils by plants and the effectiveness of several extracting solutions in removing Pu 239 and W 185 from contaminated soils were determined. The uptake of the radioisotopes by barley was soil dependent. The activity in the extraction experiments for the various soils tested was 0.1 uC/g dry soil. Barley grown in the different soils accumulated only very small amounts of Pb 210 and less Pu 239, but W 185 was accumulated in biologically significant amounts. The extracting solutions removed more Pb 210 and Pu 239 from the soil than did the barley. (NSA)

<1360>

Wilson, S.B., and E.G. Hallsworth, The Distribution of Cobalt in TRIFOLIUM SUBTERRANEUM. 1965. Plant and Soil, 23, 60-78 (University of Nottingham, Department of Agricultural Sciences, Nottingham, England)

The distribution of cobalt in plants of T. SUBTERRANEUM grown on different levels of supply of cobalt and nitrate nitrogen has been measured, and the nodules and to a lesser extent the roots have been found to accumulate much more than the leaves. The distribution of vitamin B-12-type compounds and of Co60 in the nodule have also been determined following fractionation of the nodule components by high speed centrifugation. Most of the cobalt whether present as vitamin B12, or as indicated by the measurement of Co 60 is much the same in the nodules from both effective and non-effective strains. The quantities of vitamin B12 present in both bacteroids and the supernatant are greatly increased, in relation to the fresh weight of the nodule tissue, when the supply of cobalt in the nutrient is raised. When Co 60 is incorporated into the plant a proportion of the activity is found to be present as vitamin B12, free from bacteroids, within four days of addition. After this time the supernatant still contained about 90 per cent of the activity that entered. Of this some 40 per cent was present as ionic cobalt, 19 percent as vitamin B12 like compounds, and the remainder as a compound, presently termed Factor M, which is so far unidentified. (Auth)

<1361>

Wilson, S.B., and D.J.D. Nicholas, Cobalt Requirement for Non-Nodulated Legumes and for Wheat. 1967, August. Phytochemistry, 6, 1057-1066 (Waite Agricultural Research Institute, Glenn Osmond, South Australia)

Metabolism of Co 60, as CoC12 and cyanocobalamin, in clover and wheat was studied. Cobalt deficiency was studied. Cobalt deficiency was produced in nonnodulated

subterranean clover, TRIFOLIUM SUBTERRANEUM, grown with nitrate or urea nitrogen, and in wheat, TRITICUM DURUM, supplied with nitrogen. Deficiency effects were also obtained in sterile cultures of T. SUBTERRANEUM utilizing either cobaltous sulfate or cyanocobalamin as a source of the micro nutrient. Cobamides were not detected in sterile T. SUBTERRANEUM that rapidly degraded added Co 60-cyanocobalamin. It was shown by gel filtration techniques, that over 90 percent of the Co 60 was not associated with cobalamin or inorganic Co. The separation of these Co 60 complexes of low molecular weight from plant extracts as well as radioassay techniques are described in detail. (NSA)

<1362>

Witherspoon, J.P., Field Studies of Fallout Retention by Plants. 1972. CONF-700909; Part of Proceedings of the U.S. Atomic Energy Commission Symposium Series, Survival of Food Crops and Livestock in the Event of Nuclear War held in Upton, New York, September 15-18, 1970 (Oak Ridge National Laboratory, Ecological Sciences Division, Oak Ridge, TN)

Several field studies on the retention by plants of local fallout particles (particles exceeding 44 u in diameter) are summarized. Although initial fractions of fallout intercepted varied as a function of plant-foliage characteristics and particle size, average initial retention values are similar for studies done with a wide variety of plants in different geographical regions. Rapid losses of particles from foliage and other plant parts due to weathering occurred generally during the first week following initial particle deposition. Losses from tree species during this period were several times greater than losses from crop plants. In a period of 1 to 2 weeks following deposition all plants lost 90 percent or more of the fallout particles initially intercepted. After about 3 weeks the loss of particles were relatively constant and proceeded at a slow rate (average weathering half-life of 21.3 plus or minus days) regardless of subsequent rain and wind conditions. (Auth)

<1363>

Witherspoon, J.P., and F.G. Taylor, Jr., Retention of a Fallout Simulant Containing Cesium 134 by Pine and Oak Trees. 1969, December. Health Physics, 17, 825-829 (Oak Ridge National Laboratory, Oak Ridge, TN)

Small white pine (PINUS STROBUS) and red oak (QUERCUS RUBRA) trees were contaminated in the field with a fallout simulant consisting of 88 to 175 u dia quartz particles containing Cs 134. Whole plants were harvested at intervals up to 33 days after application of the simulant, and the Cs 134 retention by each species was determined. The initial fraction of the simulant retained by foliage was higher in the oaks (0.35) than in the pines (0.24). However, after one hr, the broad leaved oaks had lost 90.5 percent of the initial Cs 134 concentrations while the pines had lost only about 10 percent. These early retention differences are related to the effects of wind on the two distinct foliage types. Effective half-lives were calculated for both species at intervals of 0 to 1 day, 1 to 7 days and 7 to 33 days. For pine trees these values were 0.25, 4.53 and 20.66 days, respectively. For oaks they were 0.12, 1.41 and 24.86 days. Loss of particles (Cs 134) was due, primarily, to the weathering action of wind and rain during the study. The effects of wind and the first rain following contamination accounted

<1363> CONT.

for a large percentage of the total radionuclide loss during the study. (Auth)

<1364>

Witherspoon, J.P., and F.G. Taylor, Jr., Interception and Retention of a Simulated Fallout by Agricultural Plants. 1970. Health Physics, 19, 493-499 (Oak Ridge National Laboratory, Health Physics Division, Radiation Ecology Section, Oak Ridge, TN)

Five species of agricultural plants were contaminated in the field with two particle size ranges of a quartz fallout simulant containing Rb 86. Initial fallout interception and retention of particles up to 8 weeks was determined. Loss of fallout from foliage due to the weathering action of wind and rain (weathering half-lives) and loss due to weathering plus radiological decay (effective half-lives) were determined for all species. The initial interception of smaller particles (44-88 μ dia) by foliage was 2.5 times that of larger particles (88-175 μ dia). Particle interception was correlated with leaf area and varied between species by a factor of 65 in terms of μ Ci Rb 86/ μ foliage. After rapid initial losses of fallout (67 percent lost the first week after deposition), differences in retention rates between species became non-significant. Retention times of the two particle size ranges were also found to be similar. (Auth)

<1365>

Witkamp, M., External Factors Influencing Mineralization and Immobilization of Some Radionuclides from Tree Litter. 1968. STI/PUB-190; CONF-680725: Part of Proceedings of a Symposium on the Use of Isotopes and Radiation in Soil Organic-Matter Studies held in Vienna, Austria, July 15-19, 1968, (p. 231-240), 593 p. (Oak Ridge National Laboratory, Oak Ridge, TN)

The kinetics of mineral elements in forest litter are being studied at Oak Ridge National Laboratory using radiotracer techniques. Special emphasis is placed on the cycling of long-lived fallout nuclides because of their potential health hazard in the food chain to animals and man. Data are being obtained from in vitro, microcosm, and field experiments and their interpretation is helped by systems analysis and analogue computer simulation of mineral flow. The results indicate that during the usual microbial bloom of newly incubated litter, loss of minerals by leaching may be reduced by as much as 50 percent as a result of their immobilization in microbial tissue. Only on the most rapidly decomposing litters will initial mineralization prevail over immobilization. After the bloom, release of accumulated minerals from the declining population and from the decaying substrate results in net mineralization that is proportional to the weight loss of the substrate. In general, rates of mineral turnover are positively related to concentration and availability of the nuclides, and to environmental factors that enhance microbial development (substrate, temperature, moisture). Faunal consumption of litter also enhances mineral turnover by exposing cell contents. Faunal consumption of microbial mass results in decreased immobilization of nuclides. Under favorable conditions, net and gross microbial immobilization by the microflora may amount to 22 percent and 61 percent, respectively, of the initial quantity of Cs 137 in the litter. Leaching (excess rain) releases only a few percent of the immobilized nuclides but

freezing, drying, and burning may result in almost complete release. Much of the remineralized nuclide is immediately reabsorbed by the substrate, in particular by charred leaves. Burning also releases minerals to the atmosphere in smoke or by volatilization. In field experiments on the forest floor, rates of mineral turnover vary greatly in time as a result of changes in weather conditions. Consequently periods of net immobilization in the forest are short and the average percent net immobilization is lower than that found in the laboratory. Thus, even though the microbial and faunal compartments are relatively small as compared with other litter compartments, their role in mineral kinetics is appreciable because of high rates of turnover. (Auth)

<1366>

Witkamp, M., Accumulation of Cesium 137 by TRICHODERMA VIRIDE Relative to Cesium 137 in Soil Organic Matter and Soil Solution. 1968. Soil Science, 106, 309-311 (Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN)

Small nylon bags containing decomposing litter or wood of tulip poplar trees labeled with Cs 137 were immersed in a nutrient solution. Spores of the fungus, TRICHODERMA VIRIDE, were placed in the solution, and after one week the mycelia growing on the bags and in the surrounding liquid were analyzed for Cs 137 content. The concentrations of Cs 137 in mycelium on solid substrate were invariably higher than those in mycelium from liquid. This may be a result of additional available Cs 137 in the bags relative to that in the liquid; of higher mineral concentration at the solid surface than in the liquid; of higher metabolic activity of fungi in contact with the solid surface; or of a higher proportion of aerial mycelia and spores on the solid than in liquid media. (NSA)

<1367>

Witkamp, M., and B. Barzansky, Microbial Immobilization of Cesium 137 in Forest Litter. 1968. Oikos, 19, 392-395; ORNL-P-3610 (Oak Ridge National Laboratory, Oak Ridge, TN)

By a comparison of loss of Cs 137 from sterile leaves with that from leaves with active microbial growth, measurements were made of immobilization of an isotope in forest litter. Leaves of tulip poplar (LIRIODENDRON TULIPIFERA) were exposed on threads in the forest floor of a tulip poplar stand, part of which had been tagged with Cs 137. After 6 weeks of incubation in the stand with Cs 137, untagged leaves with active microflora contained more Cs 137 than leaves without microflora. In the stand without Cs 137, leaves with microflora retained more Cs 137 than those without. These results suggest immobilization of Cs 137 by the microbiota on the leaves. Average retention by decaying and sterile leaves was 51 percent and 45 percent of the initial Cs 137 content. Thus net immobilization was 7 percent of the initial content and about double that for the average content during the experiment. It is suggested that microbial immobilization is a factor in the natural cycles of Cs 137 fallout in forested landscapes. (NSA)

<1368>

Witkamp, M., and M.L. Frank, First Year of Movement, Distribution and Availability of Cesium 137 in the Forest Floor under Tagged Tulip Poplars. 1964. Radiation Botany, 4, 485-495

<1368> CONT.

(Oak Ridge National Laboratory, Health Physics Division, Radiation Ecology Section, Oak Ridge, TN)

Influx, distribution, and leachability of Cs 137 in the forest floor were measured for environmental description. Rain, leachates, litter, soil and roots were collected under the crowns of tulip poplars (*LIRIODENDRON TULIPIFERA* L.) tagged in May. The Cs 137 content of the samples was measured by scintillation counting. Before leaf fall 85 percent of the Cs 137 in the forest floor was found in roots which consequently set the distribution pattern. Concentrations of Cs 137 in soil varied by 2 orders of magnitude within a few cm distance. Distribution of Cs 137 was less influenced by rainout and runoff. Ten soil cores of 7 cm³, 2.1 cm dia and 2 cm deep, were found sufficiently large to estimate local mean distribution of Cs 137 in litter and in soil, in the various seasons. Variabilities (s as percentage of X) ranged from 31-62 percent of the means. Leaf fall doubled the total amount of Cs 137 in the forest floor and increased the amount of Cs 137 in litter 15 fold. Leachability of Cs 137 in the fresh litter was nine times greater than in old litter and increased the content of mobile Cs 137 in the entire litter layer by two orders of magnitude. During winter more than half of the Cs 137 in the litter and roots leached into the soil. In spring there was renewed rainout from the canopy. The large differences in amount, concentration and leachability of Cs 137 over short periods of time and distances could only be measured by combining the results of detailed and frequent sampling using a variety of methods. (Auth)

<1369>

Witkamp, M., and M.L. Frank, Cesium 137 Kinetics in Terrestrial Microcosms. 1969. CONF-670503: Part of Nelson, D.J. and Evans, F.C. (Eds.), Proceedings of the Second National Symposium on Radioecology, held in Ann Arbor, Michigan, May 15-17, 1967, (p. 645-653), 774p. (Oak Ridge National Laboratory, Oak Ridge, TN)

Transfer of Cs 137 among compartments of terrestrial microcosms was studied using microcosms of increasing complexity. By adding one compartment at a time the role of each compartment in the kinetics of such systems can be evaluated. Analog computer simulations of the Cs 137 kinetics of various systems provided new insight in pathways and rates of turnover and stressed the importance of close contact of the investigator with both the experiment and the simulations. (Auth) (CWF)

<1370>

Witkamp, M., and M.L. Frank, Loss of Weight, Cobalt 60, and Cesium 137 from Tree Litter in Three Subsystems of a Watershed. 1969, November. Environ. Sci. Technol., 3, 1195-1198 (Oak Ridge National Laboratory, Oak Ridge, TN)

Losses of weight, Co 60, and Cs 137 from alder, sycamore, and oak leaves exposed for one year in a forest, a pond, and a brook, were exponential. Loss coefficients increased in the order: weight < Co 60 < Cs 137 at the ratio 1:1.9:4.1. For species loss, coefficients increased in the order: alder < sycamore < oak at the ratio 1:2.7:4.6. The effects of site, species, and substance were highly significant (P=10 percent). Differences between weight and minerals appear to be controlled primarily by leachability, differences between species by microbial

breakdown rates, and those between sites by rates of leaching and mechanical abrasion. (Auth)

<1371>

Wlodek, S., D. Grzybowska, and M. Bysiek, Influence of Human Activity Upon Radium 226 Migration in the Environment. 1970. Nukleonika, 15, 675-681

Radium 226 concentrations in industrial wastes, water, bottom sediments, and periphyton of a small river and its ten tributary streams, as well as in soil and meadow plants was investigated in an area of somewhat elevated natural radioactivity. A distinct influence of the human activities upon migration and cumulation of radium in bottom sediments and river periphyton was established. As a result of the 2-year-period of industrial activity in the drainage area of the above mentioned river a long zone of increased radium concentrations (about 10 km) involving the immediate vicinity of the river as well as the flood land around was formed; this zone does not present, however, any significant health hazard to the resident population. (Auth)

<1372>

Wolfsberg, K., and W.R. Daniels, Concentration of Transplutonium Actinides From Dirt Samples. 1968. U.S. Patent 3,395,992 (U.S. Atomic Energy Commission, Washington, DC)

A method is described for separating lanthanides and actinides produced in an underground nuclear detonation by extracting the lanthanides and actinides into tri-n-butyl phosphate, heavily salted with aluminum nitrate, further extracting into di-2-ethylhexyl orthophosphoric acid, esterifying this solution and passing it through an anion exchange resin column, and then separating the actinides from the lanthanides by eluting from a cation exchange resin column. (NSA)

<1373>

Wollenberg, H.A., H.W. Patterson, A.R. Smith, and L.S. Stephens, Natural and Fallout Radioactivity in the San Francisco Bay Area. 1969, August. Health Physics, 17, 313-321 (University of California, Berkeley, CA)

A compilation of gamma spectrometric data from soil samples collected at 27 fallout monitoring locations in the San Francisco Bay area revealed that natural terrestrial gamma dose rates range from 3 to 13 uR/hr with a modal value of 5.5 uR/hr (a 10-yr background dose of 480 mR). There was good agreement between the natural dose rates determined by radioactivity measurements made in the field with a portable counter and those derived in the laboratory by pulse-height analyses of soil samples. Analysis of the measurements made with the portable NaI counter from March 1958 through March 1968 yielded an average fallout gamma integrated doses for the 27 locations of 280 mR, assuming that all fallout was deposited evenly with respect to time. Roughly three times as much gamma-emitting fallout was deposited in the San Francisco Bay area between March 1958 and the end of 1960 as has been deposited since 1960. (Auth)

<1374>

Wong, K.H., V.F. Hedge, and T.R. Folsom, Plutonium and Polonium inside Giant Brown Algae. 1972, June 23. Nature, 237, 460-462 (University

<1374> CONT.
of California, San Diego, CA)

Certain marine algae accumulate Pu so effectively that they might be used to detect small concentration changes of the element in seawater, where direct determination would be difficult. In a survey made in 1971, near a coastal power reactor after reported accidental burnup of fuel rods carrying 17,000 Ci of Pu 238, Pu and other nuclides were compared in various types of algae, and large accumulations were found in several species; concentrations, however, ranged widely within species and suggested a correlation between activity and surface area. Attention was turned to comparing different tissues of one giant brown algae, *PELLAGOPHYCUS PORRA*. Samples dissected for Pu analysis by alpha spectrometry were also analyzed for Po 210; it was hoped that the distribution of Po 210 might serve as a model for predicting distributions of the less easily analyzed Pu 239 and certain other heavy metals. Concentrations of Po 210 varied significantly between different parts of the plant, and even between different sections of the same part, but were always much higher in the outermost layers; this also applied to Pu 239 concentrations, but to a lesser degree. Another finding was that for comparison of two different environments it is not sufficient merely to sample a given species, but identical sample tissue must be compared. (NSA)

<1375>

Wood, R.A., S.T. Wakakuwa, T.H. Rutherford, A.L. Beck, and R.V. Roscoe, The Sequential Separation and Quantitative Determination of Strontium 90, Cerium 144, Cesium 137 and the Stable Elements of Strontium and Calcium in Plant, Feces, Milk, and Water Samples. 1968, January. UCLA-12-676; 67 p. (University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA)

A method is described for the sequential separation and determination of Sr 90, Ce 144, Cs 137 and the stable elements of Sr and Ca in 100 to 500 gram plant or feces samples, 2000 to 5000 ml milk samples and 1 to 10 gallon water samples. Solubilization and radioexchange were initiated in plant and feces by pre-ashing at 430 degrees centigrade for eight hours and then completing the solubilization with nitric acid and hydrogen peroxide in the presence of the carriers and tracers. Milk samples were concentrated by evaporation in the presence of 1:9 acetic acid and ashed at 430 degrees centigrade for eight hours. Solubilization was completed as in plant and feces samples. Water samples were filtered, the insoluble material was separately solubilized, recombined with the sample and evaporated to salting in the presence of nitric acid, carriers, and tracers. Water was added in excess. The final digestion of any remaining organic material was completed using nitric acid and hydrogen peroxide. The alkaline earths plus cerium were separated from the alkali metals as hydroxides and carbonates. The cesium was separated, concentrated and purified using ion exchange techniques. The strontium was separated from calcium and cerium by successive 75 percent nitric acid precipitations. Cerium was separated and concentrated using iodate methods or by liquid extraction using Bis (2-ethylhexyl) hydrogen phosphate. The cerium was purified and counted as the oxide. The strontium was set aside for 14 days. The Sr 90 was determined from its Y 90 daughter. The techniques and methods described in the procedure were developed or

are standard procedures that were modified to meet the specific needs of the various Division research programs. This procedure thus represents the accumulative experience of this Laboratory in the processing and analysis of several thousand low activity plant, milk, feces and water samples for Sr 90, Ce 144, Cs 137 and the stable elements of Sr and Ca. The procedures and methods described were modified from existing published methodology and no claim is made or implied that these methods were or are the original development of the authors. The primary value of this procedure is that it was used with a large number of samples since 1963 and that semitechnical personnel can employ it and obtain good results. (Auth)

<1376>

Woods, F.W., Root Extension in a Plantation of Longleaf Pine: Investigation of a Technique Using Iodine 131. 1963. TID-21588; 129 p. (Duke University, School of Forestry, Durham, NC)

Iodine 131 was used as a tracer in field studies to determine the extent of tree roots and to estimate root extension at 3 different soil depths in a plantation of longleaf pine, *PINUS PALUSTRIS*. The I 131 was applied directly to a sterilized spot in the soil either on the surface or at a depth of 1 or 3 ft and subsequent measurements were made of the radioactivity of the bole of selected trees in the vicinity. A portable scintillation counter was used. If radioactivity was detected in a tree, it was assumed that the tree had root connections with the point of application. Results indicated that all trees over 3 in dbh that were within 10 ft of the point of application absorbed I 131 regardless of soil depth. Absorption from the most distant point of application was 22 ft for surface application and 33 ft for applications at 1 and 3 ft depths. Between these distances the number of trees showing radioactivity decreased with increasing distance from the point of I 131 application. Data are included from studies on the effect of soil sterilization on the tree roots, the volume of soil made radioactive by the I 131 used, and the retention of I 131 by clay colloids and organic matter in the soil. (26 references) (NSA)

<1377>

Yamagata, W., M. Chiba, and S. Matsuda, Deposition and Translocation of the Radioactive Fallout. 1969, December. Koshu Eisei Kenkyu Hokoku, 18, 165-186 (Institute of Public Health, Tokyo, Japan)

In order to estimate the contribution of the wind-blown surface soil to the monthly deposition of radioactive fallout, determination was made of iron content of the monthly collection of fallout at 25 localities throughout Japan during the period from April 1968 to March 1969. The iron content suggested that 10 to 15 percent of the measured Sr 90 deposition was contributed by the translocation of ground deposits through wind-blown dust. Discussion was also made on the Cs 137/Sr 90 ratios observed at various institutions in the world, and it was concluded that a representative value should be 1.6, ranging from 1.3 to 1.8 irrespective of the type of sample (deposition or air) and time of collection: higher values such as 2.7 were supposed improbable as an average for a set of determinations. (Auth)

<1378>

Yasagata, N., S. Matsuda, and M. Chiba, Radioecology of Cesium 137 and Strontium 90 in a Forest. 1969. J. Radiat. Res., 10, 107-112 (Institute of Public Health, Department of Radiological Health, Minato-ku, Tokyo, Japan; Kiri College of Technology, Gunma University, Kiri, Gunma Pref., Japan; Japan Analytical Chemistry Research Institute, Itabashi-ku, Tokyo, Japan)

The quantitative distribution pattern of cesium 137 and strontium 90 was determined in a forest area after preliminary studies at different sites. Both radionuclides were found in the fallen leaves in the highest concentration. This can be reasonably explained by the fact that the fall-out rates were the highest three years before this observation. About 80 and 63 percent of the total deposition respectively of cesium 137 and strontium 90 were found in the upper 5 cm layer of soil and 18 and 23 percent in the vegetation, of which 11.4 and 10.7 percent were in the fallen leaves. Root absorption of strontium 90 by pine tree and shrub was considered at least two times higher than that of cesium 137. (Auth)

<1379>

Yamamoto, T., K. Masuda, and M. Onishi, Studies on Environmental Contamination by Uranium. I. Environmental Survey of Uranium in Kamisabara Village, Okayama Prefecture. 1968, September-December. J. Radiat. Res., 9, 92-99 (Hygienic Laboratory, Okayama Prefecture, Japan)

In order to investigate situations of uranium contamination in Kamisabara village where uranium mines are being developed, measurements have been made on the amounts of uranium flow in the streams since 1963, and uranium contents in soil and in farm produce since 1965 by counting system and fluorimetric method. As a result, it has been found that the mean amounts of uranium flow in the streams in each year is higher at the sampling spots where drainages of galleries and the pilot refinery were disposed, and the amounts were between 5.39 and 204.5 μ g per minute. At sampling spots about 2,000 m lower than gallery and pilot refinery drainages, the detectable amounts were 0 to about 30 percent more than detected amounts in each preceding year. In general, the spots where the element can be detected gradually move downward year by year. The uranium contents in soil sampled in the village were 1.9 to 4.0 μ g per g of air-dried soil. Uranium was detected in all vegetables sampled in the village, and the contents were between 0.1 and 0.67 μ g per g of ash, while it could not be detected in all the vegetables sampled in Okayama City. On uranium contents in soils and vegetables, however, no remarkable variation with time could be observed. (Auth)

<1380>

Yatazawa, M., and Y. Yamazaki, Absorption of Fission Products by Plants (Part 5) Absorption of Gross Fission Products. 1956. Soil and Plant Food, 2, 1954-1957 (Nagoya University, Agricultural Chemical Department, Japan)

The uptake of radioactive wastes from atomic pile by 8 species of plants were studied. The results obtained were as follows. Considerable variation in uptake was associated with the 8 crops considered. The concentration factor in roots decreased in the order: Leguminosae, Solanaceae > Compositae > Gramineae. On the other hand, that in roots were: Leguminosae > Gramineae, Compositae >

Solanaceae. Addition of fertilizers and calc considerably repressed the uptake of fission products by rice plants. The distribution of gross fission products in rice plant was similar to that of strontium. The specific activity was rather high in leaf-blade and was lowest in matured grain. Chemical analysis of absorbed radioactive elements revealed the selective absorption of alkaline earths by plants. Sr 89 and Sr 90 were identified in this alkaline earths fraction. (Auth)

<1381>

Ydintseva, E.V., Influence of the Composition of Potassium, Sodium, and Calcium on the Accumulation of Cesium 137 in Crops. 1963. Izv. Timiryazev. Sel'sk Khoz. Akad., 4, 76-91

The influence of K, Na, and Ca units and acidity of soils on the accumulation of cesium in yield was studied on plants of wheat and peas. An increase of potassium content in plants and soil resulted in decreasing radiocesium content in the yield that meant that K may be used for decreasing the content of this element in plants. The same result may be succeeded with decreasing concentration of pH-ions in soil. Calcium and sodium carbonate and hydrates of Ca and particularly of Na oxides decreased the accumulation of radiocesium when soils were acidic and had no action when the soil was neutral. (Auth)

<1382>

Iermolayeva-Makovskaya, A.P., L.A. Pertsov, and D.K. Popov, Polonium 210 in the Human Body and in the Environment. Not given. A-AC-82/G/L-1260; AEC-tr-7030; p. 163-170 (Not given)

Concentrations of polonium 210 in foodstuffs and human tissues are presented. Polonium 210 accumulation in the body follows a pattern similar to sulfur. Smokers concentrate 2-3 times more polonium 210 in soft tissue than non-smokers, indicating that a major mode of entry into the human body is via cigarette smoking. (CWF)

<1383>

Younis, A.F., Study of the Effects of Different Levels of Carrier-Free Strontium 89 in the Soil on the Growth and Differentiation of Plant Organs. I. The General Effect on Pea and Lettuce Roots. 1968, October. Isotop. Radiat. Res., 1, 63-69 (University of Alexandria, Alexandria, Egypt)

Germinated pea and lettuce seeds were grown in soils containing different amounts of Strontium 89 to give beta activities of 3, 6, 9, 12, 15, 18 and 21 μ Ci/g soil at the time of planting. After 5 weeks all plants were harvested and examined morphologically and histologically. The effective threshold level of beta activity in the soil for the growth and differentiation of tissues in the two plants seems to be somewhere between 9 and 15 μ Ci/g soil; below this level there was some activation of growth, and above it a definite retardation took place. The formation of the nodules on pea roots was reduced at 3 μ Ci and completely suppressed at 9 μ Ci or more. The histological features of the pea roots suggest that the threshold level of beta activity for cell division is apparently lower than that for differentiation. (Auth)

<1384>

Younis, A.F., A Study of the Effects of Different Levels of Carrier-Free Strontium 89 in the Soil on the Growth and Differentiation of Plant

<1384> CONT.

Organs. II. Effect on Pea and Lettuce Tops.
1969, June. Isotop. Radiat. Res., 2, 71-77
(University of Alexandria, Alexandria, Egypt)

Germinated pea and lettuce seeds were grown in soils containing different amounts of Sr 89 to give beta activities of 3, 6, 9, 12, 15, 18, and 21 uCi/g soil at the time of planting. After five weeks, all plants were harvested and studied morphologically and histologically. In lettuce, the leaf area and fresh weights of tops were higher in the 6 and 9 uCi plants, and in pea, the leaf area in the 9 and 12 uCi plants was higher than in the other treatments including controls, pointing to a threshold level of beta activity at the range of 6 to 12 uCi/g soil. An interesting feature, probably not recorded before, was observed in the stem apex of lettuce, namely, the formation of a twin growing point within the same apex in the 6 to 18 uCi plants; photomicrographs of these heads are presented. (Auth)

<1385>

Yousef, Yu.A., A. Kudo, and E.F. Gloyna,
Radioactivity Transport in Water: Summary Report.
1970. ORO-490-20: 80 p. (University of Texas,
Center for Research in Water Resources, Austin,
TX)

A transport model is presented which describes the behavior of radionuclide movement in an ecological system, and considers hydraulic transport, sediment sorption and desorption, and biomass uptake and release. Solutions of the transport model are programmed and verified using data obtained from the laboratory ecosystem and the research flume. The limitations and relative importance of environmental factors affecting transport were evaluated. Recommendations for the use of this prediction model are discussed. Flume experiments limited to fresh water systems and slow-moving streams were conducted. In general, radionuclide movement followed the same pattern as Rhodamine B dye releases. However, discrepancies were observed due to interactions of radionuclides with sediments, biomass and organic debris. Therefore, before tests were conducted in the fully instrumented flume (model river), laboratory experiments with small ecosystems (aquaria) were conducted to help evaluate the functional form and factors involved in prediction models. The effects of specific environmental factors such as pH, temperature, dissolved oxygen, and oxidation-reduction potential of sunlight were studied to estimate the uptake and release rates of radionuclides. The radionuclides investigated included Zn 65, Co 58, Ru 103, Cs 137, Sr 85, and Cr 51. (Auth)

<1386>

Yudintseva, E.V., Uptake of Cesium 137 by Plants from Soils of Various Climatic Zones. 1968. Agrokhimiya, 1, 78-89

Plant uptake studies of cesium 137 from 30 Russian soils from different climatic zones and 20 turf-podzolic soils showed that within soil type the uptake is affected by the exchangeable potassium in the soil. In turf-podzolic soils the quantity of cesium 137 extracted by 0.5N KNO3 strongly reflected that available for plant uptake. (CWF)

<1387>

Yudintseva, E.V., Radioactive Isotopes of Strontium, Cesium and Other Fission Products in the Soil Plant System. 1964. Izv. Timiryazev.

Sel'skokhoz. Akad., 2, 169-181

The results of studying the behavior of radioactive fission products especially those most dangerous to man, Sr 90, Cs 137, in the soil-plant system led to the suggestion of several practical measures for decreasing the content of these isotopes in agricultural products. Such measures include deep burying of the fission products, liming on acid soils, introduction of various chemical compounds and the use of appropriate fertilizers. The extent to which these measures or combinations are used would be determined by the nature of the soil, the isotopic compositions of the fission products, and other conditions. Under some conditions proper selection, use of contaminated grain as seed in a different region, and purification of light soils would be feasible. (NSA)

<1388>

Yudintseva, E.V., I.V. Gulyakin, and V.A. Demin,
Accumulation of Strontium 90 and Cesium 137 in Vegetables. 1968. Agrokhimiya, 3, 101-110

The uptake of radiostrontium in vegetables was found to decrease in the following order: beets, carrots, potatoes, cabbage, and tomatoes. Foliar adsorption and translocation of cesium 137 was much greater than that observed for radiostrontium. The greatest accumulation of radiostrontium in potatoes occurred in those grown in turf-podzolic soils. (CWF)

<1389>

Yudintseva, E.V., I.V. Gulyakin, Z.M. Polcalkina, and T.A. Kozhenyakina, The Role of Clay in Strontium 90 Availability to Plants. 1967. Agrokhimiya, 8, 100-107 (Biophysical Laboratory, Moscow, USSR)

The results obtained show that the clay fractions of soils play a big role in the decrease in the availability of Sr 90 to plants and its accumulation in harvests. The increase of the quantity of clay in turf podzolic medium-clay soil can significantly decrease the concentration of radiostrontium in the straw of plants and somewhat decrease its accumulation in the grain. The addition of either clay or soil containing increased quantities of this fraction to light sandy soil can sharply decrease the accumulation of strontium 90 both in the straw and in the grain of the plant. Such an effect of the clay fraction caused a very stable fixation of the radiostrontium in clay. The supplementary soil and clay fractions of this soil adsorbed 91.5 and 90.1 percent, respectively, of the quantity introduced and 91.9 and 70.9 percent of the absorbed quantity were displaced by 0.5N solutions of calcium chloride from the soil and clay, respectively. (tr-Auth)

<1390>

Yudintseva, E.V., I.V. Gulyakin, and A.N. Alpatova, Effect of Soil Texture on the Accumulation of Cesium 137 in Wheat Yield. 1967. Agrokhimiya, 6, 82-89 (Biophysics Laboratory, Moscow, USSR)

The Cs 137 uptake by plants and its accumulation in wheat crops was in direct dependence on the size of the soil particles. The smaller the soil particles, the greater the concentration of the nuclide in the crop. The stability of the fixation of the adsorbed radiocesium was increased with decreased diameter of the soil particles. Oozy soil fractions very firmly fixed Cs 137 and

<1390> CONT.

therefore its uptake in the plants and accumulation in the crops was reduced more sharply than fractions of clay and sand. In its effect with respect to the decrease of the uptake of radiocesium in plants, oozy fractions were equal to, and in a series of cases, decreased the concentration of Cs 137 in the wheat crop to a greater degree than soils from which the ooze was removed. (tr-Auth)

<1391>

Yudintseva, E.V., I.V. Gulyakin, and Z.M. Polomkina, Plant Uptake of Strontium 90 and Cesium 137 as a Function of their Sorption by Mechanical Fractions of Soils. 1970. *Agrokhiimiya*, 2, 30-39

A study was made of the absorption of Sr 90 and Cs 137 by sieved and classified fractions of two different soils, and the uptake of these isotopes by oat and wheat plants. The two soils were: a turf-podzolic medium-argillaceous soil from the region near Moscow, and a leached-out black earth from the Tambov area. Mechanical classification ranged from fine sand (0.25 to 0.05 mm) through coarse powder, medium powder, fine dust, and silt (<0.001 mm). The uptake by plants of Sr 90 and Cs 137 was dissimilar in the various sieve fractions of soil, and was explained by these properties of the soil fractions which give rise to their sorption behavior with respect to the two nuclides. The difference in mineralogical composition of the silt fractions of the two soil types was primarily responsible for the firmer retention of Sr 90 and Cs 137 by the black-earth silt fraction than the podzol silt fraction, and correspondingly less availability of these nuclides to the plants. (NSA)

<1392>

Yudintseva, E.V., I.V. Gulyakin, and V.Z. Panov, Accumulation of Strontium 90 in Plants on Various Soils. 1969. *Agrokhiimiya*, 1, 75-84

Radiostrontium 90 uptake studies were conducted by growing oats under greenhouse conditions in 36 Russian soils. The results confirmed the previously obtained relationship, viz, as the content of exchangeable calcium in soil is increased the uptake of strontium 90 is decreased. The authors contend the quality of radiostrontium extracted by a natural salt can be used to predict plant uptake. (CWF)

<1393>

Zinov'eva, V.K., The Content of Strontium 90 in Soil. 1962. A-AC-82/G/L-323; AEC-tr-4599; Part of Shvedor, V.P. (Ed.), Evaluation of the Contamination of the Biosphere by Products of Nuclear Tests, (p. 95-102) (Academy of Sciences, Moscow, USSR)

A method of extracting Sr 90 from soil is described. Results of analyses of soil samples from Leningrad Oblast' in 1956, 1957, and 1958 showed Sr 90 contents of 2.1, 2.55 and 7.3 mCi/km², respectively. (ST)

<1394>

Zotimov, N.V., Measurement of Snow-Water Reserves Using Natural Soil Radioactivity. 1968, Spring. *Isotop. Radiat. Technol.*, 5, 212

The results of preliminary tests indicate that

under some conditions it may be feasible to measure snow-water reserves by determining the degree to which the snow cover attenuates the natural soil radioactivity. The method is described. (Auth)

<1395>

Zsoldos, F., F. Sirokman, and E. Cseh, Rubidium Uptake and Exchange of Roots Influenced by Low Temperature and Some Inhibitors. 1969, February. *Z. Pflanzenphysiol.*, 60, 169-171 (Josef A. University, Szeged, Hungary)

The exchange of Rb 86 and K was studied at different temperatures in excised roots of rice and sorghum. Roots of 8-day-old rice seedlings and of 5-day-old sorghum seedlings were from plants grown in a 10(E-4) M solution of CaSO₄. Before the absorption period they were kept in distilled water for 15 to 20 min. The absorption solution was 5 x 10(E-4) M RbCl 86 containing 5 x 10(E-5) M of NaF were used. In short-term experiments a considerable part (about 50%) of the absorbed Rb 86 was exchanged with K ions under the effect of cold shock at 1.5 degrees Centigrade. This process was significantly slower at 8 degrees Centigrade, where there is no shock effect, than at 1.5 degrees Centigrade, and at 20 degrees Centigrade it slowed still more. The addition of DNP to the absorption solution of RbCl did not appreciably influence the ion uptake of the Rb ions of excised roots of sorghum at cold shock effect temperature. Consequently, under this condition the Rb 86 ion uptake is independent of metabolic activity. (NSA)

<1396>

Zuev, N.D., and R.W. Ponomareva, Influence of Strontium 90 on Potato Yields. 1970. *Radiobiologiya*, 10, 456-458

Data were obtained on the dependence of the growth, development, yield, and viability of potato tubers upon the density of contamination of the soil by strontium 90. The greatest injurious effect among the plants is observed at contamination levels of 250 and 1250 mCi/m². (Auth)

<1397>

Zwarun, A.A., R.H. Miller, and R.E. Franklin, Influence of Culture Filtrates of Soil Fungi on the Absorption of Cerium 144 and Strontium 90 by Excised Roots. 1969. *Soil Science Society of America Proceedings*, 33, 632-634 (Ohio State University, Columbus, OH)

Culture filtrates from *ASPERGILLUS NIGER*, *ASPERGILLUS* sp. and two species of *PENICILLIUM* were studied for their effect on absorption of Ce 144 and Sr 90 by excised roots of soybean and barley. Filtrates from both species of *ASPERGILLUS* and one of the *PENICILLIUM* markedly decreased the absorption of Ce 144 but had little effect on Sr 90. Citric acid was found in the three active filtrates while an unidentified organic acid was found in the three active filtrates while an unidentified organic acid was found in the other. The reduced absorption of Ce 144 could be duplicated by citric acid at concentrations greater than 10(E-2) M. Kojic, glucuronic, and 2-ketogluconic acids had no effect on absorption of Ce 144, but kojic and 2-ketogluconic acids reduced Sr 90 absorption by soybean roots. (Auth)

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